AMERICAN MACHINIST

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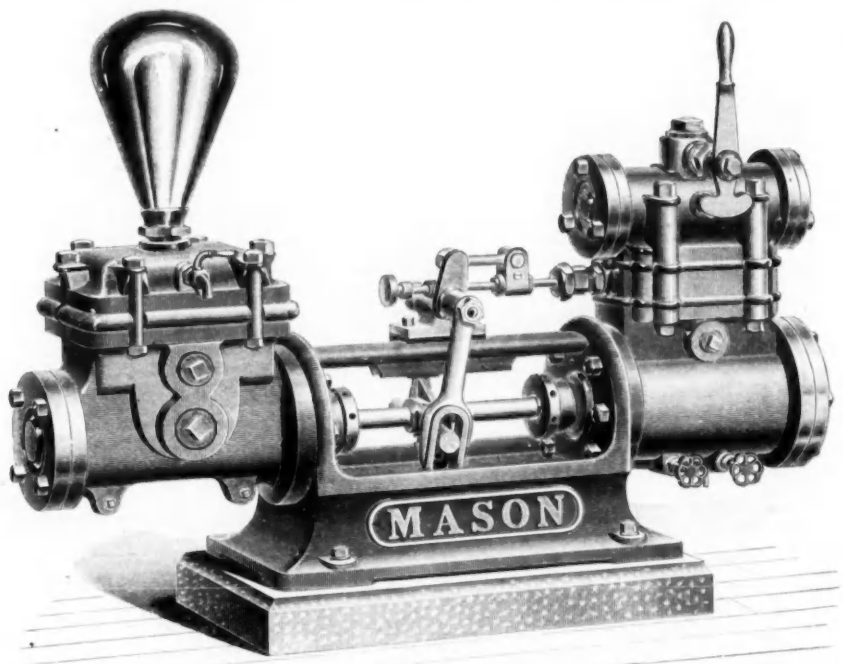
Improved Direct-acting Steam Pump.

The accompanying illustrations present the latest development of a steam pump manufactured by the Mason Regulator Co., Boston, Mass. In this pump the action of the valves is such as is claimed will maintain a perfectly continuous motion of the steam piston, while operating even at the slowest speed, and under any pressure; thus avoiding a "dead center," and rendering the pump absolutely reliable in its action.

The positive action is brought about in an ingenious manner by a valve mechanism not found in other direct-acting steam pumps. This valve arrangement consists of two D-slide valves; one called the preliminary valve, and the other the main and auxiliary valve combined, both working on the valve seat of the main steam cylinder, side by side, and receiving their motion by a yoke, connected to the valve stem by means of a collar and T-slot, this yoke sliding in a raceway contained in the steam chest (Figs. 1 and 2, see page 42).

The duty of the main valve is to alternately admit and exhaust steam to and from the main steam cylinder, in the usual manner, and also to control an auxiliary port. This single auxiliary port, being made common to both ends of the auxiliary cylinder, through the action of the preliminary valve, which acts as a switch, thereby alternately connecting the single auxiliary port to either end of the auxiliary cylinder. It will be seen from this arrangement that only one active auxiliary port is required, the others being inactive, and serving only as passages, thereby permitting one auxiliary port to work in common with either end of the auxiliary cylinder.



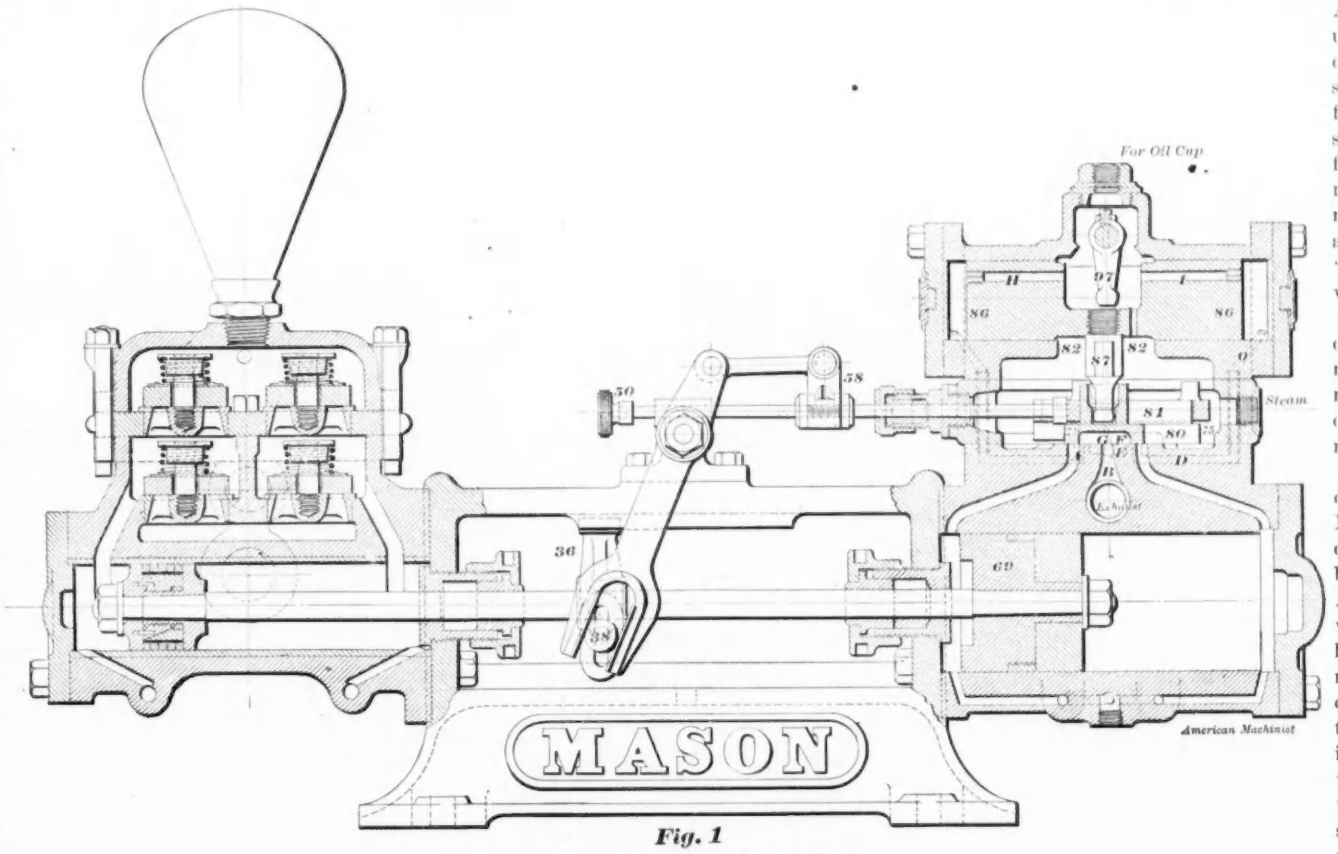


Fig. 1

IMPROVED DIRECT-ACTING STEAM PUMP.

The operation is as follows: Steam is admitted to the steam chest at the end marked "steam," filling the chest 75, in the central portion of the auxiliary cylinder 82, between the two piston heads of the auxiliary piston 86, filling both ends of the auxiliary cylinder through the passages *H* and *I*. As will be seen from the cut, the piston 69 is at the left-hand end of its working stroke, while the yoke 81, and the preliminary valve 80, and main valve 79, have been carried to the right, bringing the auxiliary cavity *G* in the main valves, over the auxiliary port *E*, thereby connecting the right-hand end of the auxiliary cylinder through the passages *C D E* and *G* to the main exhaust *B*, permitting steam to exhaust from this end, and unbalancing the auxiliary piston 86. This is sufficient to cause it to drive to the right, by the pressure on the opposite end, and carrying with it the valve pin 87 and main valve 79 (which is provided for by sufficient lost motion in yoke 81), thereby causes the auxiliary cavity *G* in the main valve to travel past the port *E*; this prevents further exhaust, and cushions the auxiliary piston 86, and in so doing, opens the left-hand port *A* to admit steam to the main piston 69. At the same time, the right-hand port *A* is opened to the exhaust *B*, by means of the cavity *F* in the main valve, which reverses the motion of the pump, this action being repeated at the end of each stroke.

Should it be found that the crosshead travels out of center, the stroke can be "evened up" by slacking off the clamping screw 58, and turning the valve stem by means of the knurled head 50.

The length of stroke of the pump can be adjusted in either direction. To shorten it raise the crosshead roll 38 in the crosshead 36. To lengthen the stroke lower the stud 38.

The hand tappet lever 97, as shown on the outside view, is for the purpose of operating the auxiliary piston and main valve by hand, should it stick or set from disuse. Should the auxiliary piston fail to drive under a high rate of speed, the main valve will be moved far enough mechanically to admit steam and reverse the pump.

One important feature which this pump possesses is that the auxiliary cylinder can be removed from the steam chest without in any way disturbing the valve gear inside.

The pump is made with special tools, so that the same parts on each size are interchangeable. The valve operating lever has hardened steel contact pieces working on a hardened steel roll.

The National Convention of Manufacturers.

We have received from those in charge of the preliminary arrangement at Cincinnati a very handsome invitation and statement with program of the proposed meeting of manufacturers for the organization of a National Association. Accompanying this is the following:

The assembly in Cincinnati on January 22, 1895, will be a convention fairly representative of the manufacturing interests of the United States.

It will be an experimental assembly.

Its object in the first instance is simply to consider and reach conclusions on the main question, *i. e.*, that of forming a National Association of Manufacturers.

The main question naturally embraces several essential elementary questions: 1st. Expediency. 2d. Feasibility. 3d. Method.

After the vote is taken upon the preliminary question, "Should such an association be formed?" and "Can such an association be formed?" it will be necessary to devote most careful deliberation to the questions "How?" and "To what end?"

The springing and discussing of subordinate issues before the main question has been determined, must only retard results.

The preliminary inquiries issued by the Manufacturers' Association and reiterated by the Committee of Arrangements and Invitation in their very handsome and elaborate invitation and circular, which goes out to-day, are intended in a purely tentative way to secure in advance of the meeting some general index of prevailing sentiment among manufacturers generally upon the main question. To this main question: "Do you favor the organization of a National Association of Manufacturers?" replies thus far received are almost unanimously affirmative; we say *almost*, because to any question, upon first blush, a certain conservative class of business men will enter a negative, which naturally

opens the door for discussion. It is perfectly proper to say that the number and force of negatives thus far recorded have not dampened the ardor of the promoters of the movement.

Upon the second tentative inquiry, "Will you be present or represented?" the affirmative vote is so largely in the majority as to promise a representative gathering.

Answers to the third inquiry which calls for *names* of those who will come, display a roster which affords assurance that whatever action is taken by the convention will be wise and deliberate.

Water Front for Boilers.

With this we give an illustration of a new water front for horizontal boilers recently brought out by the Tonkin Boiler and Engine Works Co., Oswego, N. Y. This water front (shown at *A* in the illustration) takes the place of all the brickwork generally used in front of horizontal tubular boilers and acts as a heater. The feed water is introduced at the bottom of the front and passes into the boiler through the hole *B*.

With this arrangement the necessity of lining up the front end of the furnace with fire brick is avoided, and the regular cast-iron front is kept comparatively cool, which tends to reduce the liability of its cracking.

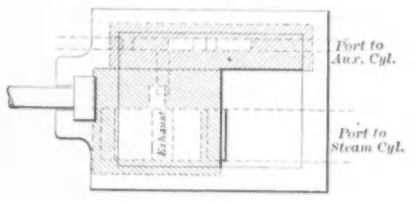


Fig. 2

American Machinist

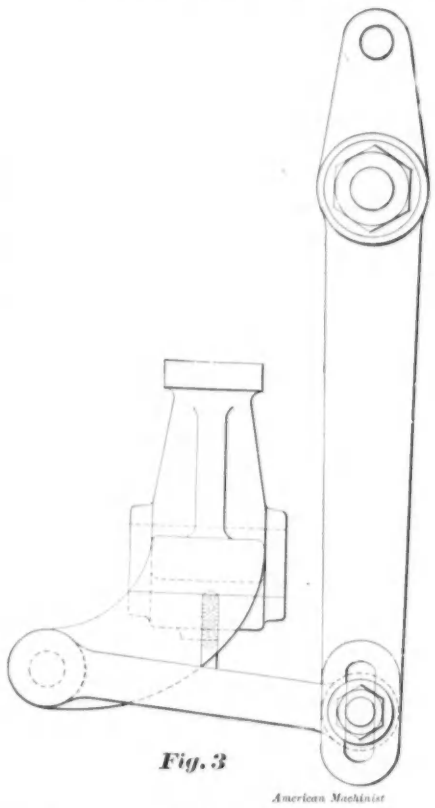


Fig. 3

American Machinist

IMPROVED DIRECT-ACTING STEAM PUMP.—SEE PAGE 41.

Chucks and Chucking as Applied to Patternmaking.

BY JOHN M. RICHARDSON.

Comparatively few pattern shops have what a machinist would term a chuck, *i. e.*, one having either three or four jaws which act independently, or else in unison when moved toward the work to be held. Such a tool, however, will far more than pay for itself in any place where there is much turning which must be reversed before being finished, and which is sufficiently strong to be grasped by the jaws without being sprung (such as gear blanks, etc., of a comparatively small diameter), and it will save many a journey to another part of the shop to a machinist's speed lathe, when a hole of any size is required to be bored in either wood or metal.

One of these chucks, to be of value to a patternmaker, must be of as light construction as possible, owing to the high speed at which it must be run, and of the scroll variety where the power required to tighten it moves all the jaws at the same time, and it should have a range sufficient to grasp anything at least 6 inches in diameter, and from that down to 0. I should hesitate to recommend one of much greater capacity, for fear it might jar the lathe when running at full speed.

The tool whose usefulness I have just outlined has a comparatively limited range on general pattern work, although like many another thing, it is good as far as it goes, so now I will come to the subject of chucking as practiced everywhere by patternmakers. A chuck and a face plate seem to be often used as synonymous terms.

Whether this is strictly correct or not, I cannot set myself up as an authority to decide, but if I were to be asked for a definition of each, I should answer that, to my mind, a chuck was a tool to grasp or hold something while being revolved, and a face plate was a device on which to fasten something for the same purpose, though this may very likely seem like "a distinction without a difference." The screw chuck is almost universally used to hold all small work while turning the diameter and front face when it is not turned between the lathe centers. So far as my observation has gone, these are of two varieties, each being a disk of cast-iron with a screw in the center, one having a hub which screws over the lathe spindle, and the other having a hub which screws over the end of a shank, thus allowing the parts to be separated to insert different lengths of screws while the shank itself fits the taper hole in the lathe.

Both are precisely the same in effect, and the two important things about them are to have the disk run absolutely true with the screw exactly in the center. The hole should be a trifle smaller than the wire of the screw, so that it can be driven in tightly, but not so much so that it cannot be driven out with a blow of the hammer on the point.

This is desirable, for some work requires a longer screw than others to hold it properly, and if the point becomes bent or gets blunt, it is but the work of a moment to drive it out and insert another.

If a very short screw is wanted for a certain job, and it does not seem desirable to remove it and replace with another, the same result can be attained by screwing a piece of wood to the chuck so that the screw will project the proper distance, and then just truing up the piece so that it will run perfectly true.

On small work the screw chuck not alone answers to hold the piece while being turned to the right diameters and the proper shape on the front face, but is used in chucking the piece so that the other face can be brought into position to turn. I will describe two ways, the first of which I do not recommend if any great accuracy is required, while the second, which is the almost universal method, can be used with absolute accuracy.

In the first case as soon as the piece is turned just spot the center with a pointed tool, and into this cavity press a twist drill about the size of the body of the screw, holding it firmly with a pair of pliers or a hand vise. Next remove the piece and screw it back on the chuck, and, as the hole just drilled is the size of the body of the screw, the threads will throw it but little out of center, still, when the work is revolved it will be nine times out of ten very slightly eccentric.

When possible on screw chuck work have the block to be turned enough longer than the screw, so that it can be severed with the parting tool without striking the screw, and have a faint circle also traced on the piece as a guide when squaring up the second face. This latter precaution is not quite as necessary in turning a piece chucked by the method just described, as every thing is in sight, but it is very necessary when work is chucked in the following manner:

First fasten a disk of wood to the screw chuck, and to make it more secure, put screws through the iron flange into the piece if it is provided with holes, which should be the case, for it is not safe at all times to rely on the screw only. Now turn into the wooden disk or face plate a short distance exactly the diameter of the part to be chucked. A quarter of an inch is sufficient for light work, and there must be a perfect fit between the two, that is to say, enough friction to hold the work securely while one is finishing the turning. In removing the piece, if it is found impossible to start it with the hands, place the beveled edge of a wide chisel close to the face plate, and pry the work slightly, first on one side and then on the other. This will be sufficient in nearly all cases to loosen it.

A good deal of care must be exercised in chucking work, or too loose a fit will be obtained, and the work will not stay at all, or else the friction will be so slight that the piece will take a journey across the shop, the moment the turning tool touches it. When the fit is but a trifle loose, there are several tricks that come into play to remedy the defect, two of which I may mention.

One is, to place some strips of paper (not less than three) at equal divisions across the edge of the depression turned, and then press the piece in firmly, letting it bottom on the paper, which at the same time keeps the work truly centered. Another is, to wet the edge of depression with hot water, and press the work in at once, and finish turning. Either way is very good, but if there is but a trifle to take up, I prefer to use moisture, as it is much quicker and holds firmly.

When one does not know the exact distance the work has been forced into the chuck, and at the same time has forgotten to strike a circle before reversing, as a guide to turn to, there is no need of being dismayed, or removing the piece to take a measurement, as a very simple trick now comes into play. Just take a gouge, and cut back a little place into the face plate or chuck, far enough to see the edge of work, previously pressed in, then it is perfectly easy to find the distance required.

A very large proportion of pattern work is entirely outside the range of the screw chuck, and it becomes necessary to employ something larger. We might divide work into three classes for convenience, first, small, that is, such as is adapted to the screw chuck; second, medium, which is larger than the first, but still capable of being swung between the ways of the lathe, and third, large, which must be swung on the spindle at the opposite end of the head stock, and turned with tools resting on an independent rest, usually called a tripod rest. This sort of rest can be moved into any position desired with relation to the work, and should have a projection near the base of one leg, on which the operator may rest his foot, so as to steady the affair while using it.

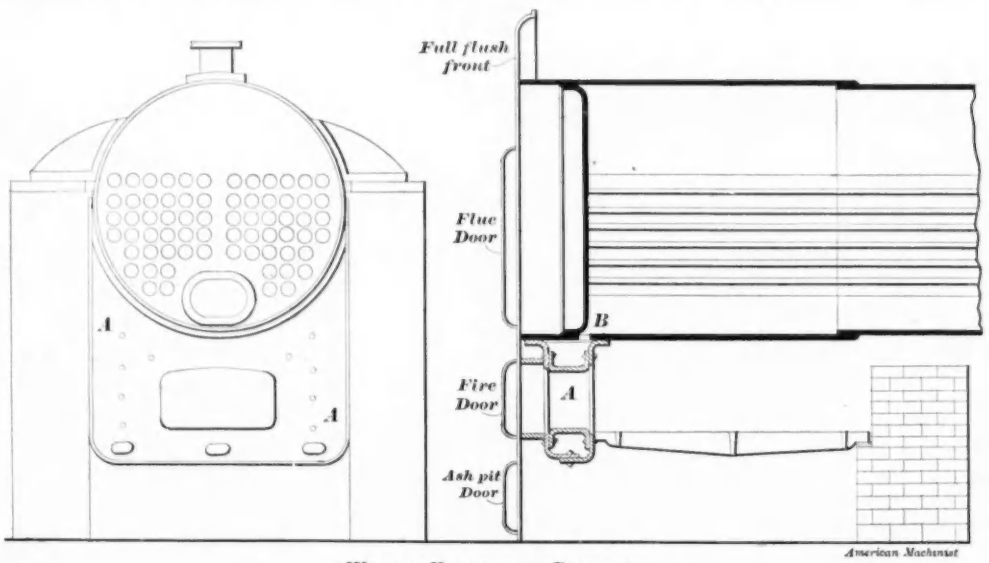
But to return to chucks of the medium size, we must look more for strength and safety than in the first. These are usually a piece of stock from 1½ to 2 inches thick, screwed firmly to the iron face plate that goes with the lathe, or else to a hardwood one, such as I described making in a former article. To chuck a piece of work on one of these by cutting into it when over a foot in diameter, means too great a waste of stock, for a few operations of this kind will ruin it. So the better way is to true it up on both the face and edge, so that it will be in perfect balance, and then take some blocks (not less than four) and fasten each with two screws at equal intervals, to a circle a trifle smaller than the piece to be fitted, and then turn into the blocks instead of the face plate. These blocks should be of sufficient thickness so that one can turn in somewhat deeper than would be necessary on small work, in order to hold the piece firmly. On work which presents much surface to the face plate, it is better to put several screws through the face plate into it, in order to make things sure, and perhaps save a severe blow, as a piece of work flying out of a chuck will go nearly in the plane of revolution, and it generally happens that the operator's head is uncomfortably close to this plane.

When the work is very thin, as in gear covers, etc., and there is no chance to use screws, then we must proceed cautiously while turning, and have as nice a fit between the blocks as possible, and it is well to toe nail a brad through each block into the piece. This helps somewhat to lock it in, and the brads can be easily withdrawn with a pair of pliers as soon as the turning is completed, and the blocks removed, as the chances are that they will never be needed screwed to the same circle again, although it is well to save them, for they may come in handy next time, and will thus save the time of sawing them out, and boring the screw holes.

As to the manner of constructing wooden chucks of various sizes there are, probably, differences of opinion, and where one man would use one sawed from a solid piece, another would make a better one of four or six sectors with a large tongue set in every joint to strengthen it. For my part I consider one 16 inches or less in diameter good enough for ordinary work as a general thing when in one piece, for any chuck should always be trued up just before attaching any work, and it seldom changes its shape during any one time that it is used.

If segment work is built upon it, the tendency will be to hold it in shape rather than otherwise.

I consider it bad practice to make a chuck in one piece, and then screw and glue two battens across the back at right angles to the grain just outside the iron face plate to which it is attached, even if the whole thing runs in perfect balance, for the following reason: Suppose segment work to be put on



WATER FRONT FOR BOILERS.

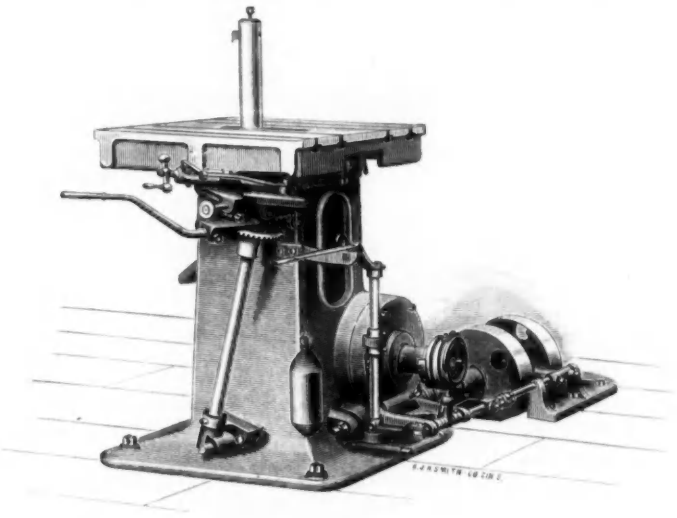
a chuck of this description and hand screws fitted, then removed while the next layer is started. There will be part of these opened one length to accommodate the battens, and the rest to the thickness of the chuck only, and if in clamping the second layer we happen to pick up one fitted at first for the chuck and layer only, and try to use it now to go over batten, chuck and second layer, we have extra work to perform, in changing the clamp a distance equal to the batten over what we otherwise should. However a chuck may be put together always have it of a parallel thickness, at least where the clamps are to be fastened.

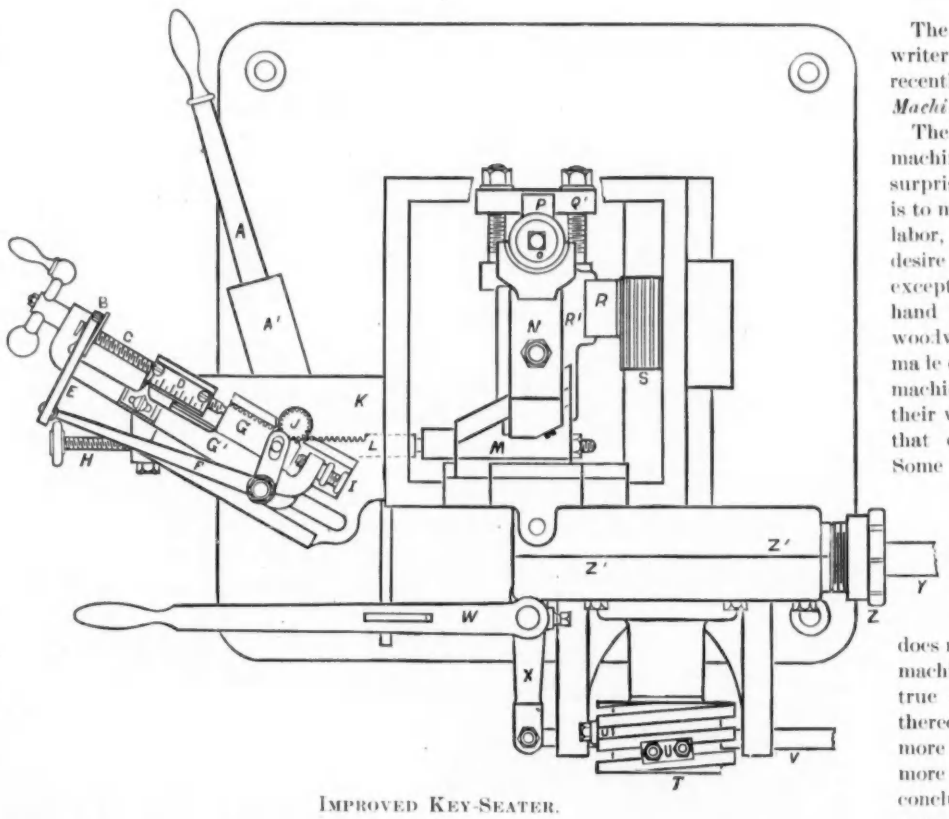
On large work, which must be swung outside the lathe bed, it is sometimes necessary to have a chuck more elaborate than any that I have described, insomuch that it must be strong and not sprung out of its proper shape. These are sometimes made by framing four or six strong arms together so that they all lie in the same plane, and screwing the largest face plate which fits the lathe to the center of these radial arms, next fastening wide and strong segments to the other side of these spokes, near their extremities, on which the work may be built up or attached as in the nature of the case may seem best.

An Improved Key-seater.

We present on this page an illustration of the Giant key-seater. The engravings show only the 14-inch stroke machine, they being built, however, in five sizes, ranging from 10-inch to 30-inch stroke, which are the nominal strokes, the actual motion of the cutter being 1 inch or more greater. These machines have been greatly improved since they were illustrated and described in our issue of August 28, 1890.

The column and worm gear casing is made of a single, heavy casting, thus avoiding extra joints and much increasing the rigidity of construction. The rack and pinion are cut from solid steel, the worm gear and screw (running in bronze bearings) are inclosed in the oil-tight gear casing, and the driving mechanism is a very powerful friction clutch, working silently and so quickly that the machine will operate with a stroke of less than $\frac{1}{8}$ inch. To provide for straight or taper key-ways the table is arranged to tilt in either direction, the amount of taper being shown by a pointer on a graduated scale at the back of the machine. In operation the cutter bar is fed against the work, while the table remains stationary. This arrangement entirely overcomes the difficulty which arises in obtaining the feed by moving the table, and, when in heavy work, the table is loaded with a weight of from 1,000 pounds up to several tons, as it frequently is, the advantage of moving the tool instead of the table becomes decidedly manifest. The cutter bars are made of steel and are round, the clamps for holding them being so arranged that the ordinary or special bars can be very quickly attached. A solid support for the cutter bars is placed close to the top of the table, which, with the large size of the bars, effectually prevents deflection. The great strength and rigidity of all the parts with the powerful gearing, make the machine exceedingly effective for all ordinary work; occasionally, however, it becomes necessary to cut key-ways as long as the full stroke of the machine, where the hub may be elevated several inches above the table as by the rim of a pulley; in a case like this the cutter bar may spring back slightly when at its extreme upward stroke. To prevent all such springing, there is provided a simple attachment, which, inserted in the hub behind the cutter bar, affords a perfectly rigid support. With the aid of this attachment it becomes possible to use long special cutter bars having two cutters, by means of which each end of a chambered hub, or both hubs, of a double-arm pulley can be cut at once, thus almost practically doubling the capacity of the machine on such work. The 14-inch stroke machine has in this way been used to cut key-ways 30 inches above the table. One noteworthy feature is the extreme ease with which the cutter bar is moved and held against the pressure of the cut. It is well known to machinists who have had experience with different styles of key-seaters, that in some cases it is quite difficult to hold the tool into the cut, especially if it is dull. In a recent instance a machinist was seen with a strap thrown over his shoulders and attached to the operating lever, that he might at each stroke throw the whole strength of his body into the effort to hold the tool to its work. In the Giant key-seater, the guide bar, upon which the crosshead holding the tool bar slides, is so firmly locked in whatever position it may be, yet is so easily moved by the operating lever, that the slightest touch is sufficient to control it. Referring to the outline engraving, which represents a plan of the key-seater, and shows some of the more important parts, the friction clutch pulleys are attached to the extended end of the shaft *V*, and are operated by the rod *V*, which in turn is moved by the adjustable tappets *U*, attached to a helical grooved hub *T*. *Z* is the casing holding the worm gear and screw. *S* is a steel pinion which is as much wider than the rack *R* as the extent of the feed motion. *P* is the cutter, and *O* the cutter bar, which is clamped to the crosshead *R*, sliding on a guide bar which extends the full length of the machine, and is rectangular in shape, very stiff and accurately fitted. In the larger sizes, this guide bar with the crosshead and cutter bar attached are quite heavy, and it would be difficult to move them easily were it not for the fact that the whole weight is hung in suspension, and practically all of the friction due to the weight is eliminated.





IMPROVED KEY-SEATER.

The wedges *M* are moved by the operating lever *A* which is attached to the shaft *J* having the pinions engaging in the racks *L*. The motion of the lever *A* is limited by the distance which the feed rack *G* can move between the ends of the feed screw *C* and the adjusting screw *I*. At each stroke the screw *C* is drawn out slightly to the amount of the feed. This can be done by hand or automatically through the lever *F* and pawl *E* acting on the ratchet *B*. The amount of feed can be varied to one or more notches on the ratchet by the adjusting screw *I*. The automatic feed greatly increases the capacity of the machine in many kinds of work. By means of the hand lever *W* the machine is instantly stopped, and can be started in either direction. In cutting key-ways the small pointer is set at the zero mark on the scale *D*, when the tool begins to cut, the depth being then indicated on the scale, and when it is finished the stop gauge *H* can be screwed up against the end of the rack *L*, and after that any number of key-ways may be cut to exactly the same depth.

An attachment is furnished to bolt to the table for centering the work from the outside. To center the work by the hole there is a simple little device which slips onto the top of the cutter bar; as this can be put on and taken off after the work is on the table, it is much more convenient than the centering device formerly used, which required to be fastened to the table before the work could be placed. For holding work of large diameter there are furnished steel extension bars which fasten to the side of the table and are supported at the outer ends by jack screws.

For cutting heavy racks or ratchets in steel or iron an extra rack-cutting attachment is made. The tools furnished for this purpose are of a proper shape and can be repeatedly ground without changing their form. For such work the machine is very effective.

Several parties using the machines find them excellently adapted for cutting steel ratchet wheels and similar work, stating that it is far more satisfactory than doing it with milling cutters.

Special attachments can also be furnished for rapid key-seating in very light work. Recently key-ways which were $\frac{3}{8}$ inch wide and 2 inches long were cut at the rate of 7 in 5 minutes, the pieces being chucked and removed without stopping the machine. Key-seats 6 inches long and $\frac{1}{4}$ inch wide were cut in two steel pinions in 20 minutes which included the time of fastening and removing. A wheel weighing 1,200 pounds, and which was rather difficult to chuck, was put on and taken off of the machine in 55 minutes, the key-seat being 14 inches by $\frac{1}{4}$ inch by $\frac{3}{8}$ inch, the actual time of cutting being 9 minutes. These instances illustrate the great capacity of the machine, but it is more clearly shown where there are large numbers of duplicate pieces to be operated upon. It is very powerfully geared, the largest size cutting key-ways $3\frac{1}{2}$ inches wide and 30 inches long, taking the full width at each cut.

The driving shaft is near the floor in the smaller machines, and in the large sizes it comes beneath the floor, being so arranged that the belts can come from any direction; the shaft and the rod which shifts the friction clutch may be of any length to put the belts entirely out of the way, thus the machine may stand in the middle of the floor and the belts be near the wall, offering no obstruction to the swinging of cranes. The makers are Mitts & Merrill, of Saginaw, Mich.

Why American Woodworking Machinery Is Damaging English Manufacturing Interests.

The following letter by an American writer, who signs himself J. T. B., was recently published in an English journal, *Machinery*:

The mighty advance in woodworking machinery in the United States has evoked surprise everywhere. In America the idea is to make everything of wood without hand labor, automatically where possible. This desire has been so successful that it is a rare exception a factory is found employing hand work. Every known description of woodwork, out of every kind of wood, is made entirely by machinery. Many of these machines are veritable wonders, performing their work with a readiness and an accuracy that excite the most profound attention. Some of the English experts say of them that they are the best examples of ingenuity ever produced, but of a lighter construction than the English make; but one must bear in mind that American iron when cast into form is very much tougher, and hence does not require so much of it to give their machines strength and solidity. This is hardly true of English iron, and in consequence thereof their machines contain a great deal more weight in iron, and consequently look more massive; but by experience it is proved conclusively that the later improved American machines are just as strong and just as capable in durability as those made by the English makers.

Progressive English manufacturers—and there are a few of them—are gradually awakening up to the fact that if they want to hold their own in the commerce of the world, they will be compelled, through necessity, to employ the later and far more economical methods to produce their manufactures. To do this they will have to turn to the Americans, much as it may be against their inclinations.

American furniture made entirely with machinery is now getting foothold in England, and attracts the admiration of English buyers, not only for the beautiful designs and finish, but for superb construction, and lastly, at a moderate price. Other articles of wood for domestic, vehicle, agricultural, building uses, etc., are fast creeping in, to the disadvantage of the English manufact-

urer. Indeed, wherein the American manufacturers succeed it is only through the use of machinery, and therefore the Englishman, in order to protect himself from encroachment, must adopt the American idea of using American machinery, for is it not a fact that the Englishman is behind the times in the getting up of "up-to-date" woodworking machinery? If this statement is not correct, show us the fallacy of it. Machinery saves time and labor, consequently money.

Styrian Steel.

Messrs. Houghton & Richards, 148–150 Oliver street, Boston, who are introducing in this country the Styrian tool steel, send us the following interesting historical note regarding this steel. Probably no one will dispute the history, but as to the claim made in the last paragraph there would, naturally, be some difference of opinion:

"The Styrian tool steels are something entirely new in the way of tool steels in this market. They are made from the ores taken from the historical Ore Mountain of Erzberg, in Eisenerz, Styria. This mountain is conical, is about 4,800 feet above the sea level, and is a solid body of ore. Iron ore has been quarried from it from the very earliest antiquity, for it is believed that the 'Noric' iron of Tacitus, Ovid and Horace, was made from ore quarried from the face of Erzberg or its immediate neighborhood.

"Erzberg belonged to the Roman province of Noricum, and the ore is known to have been quarried by the Romans. The works have been in operation ever since, and the mountains appear to be full of inexhaustible treasure. Unfortunately, a fire which occurred in Eisenerz in the year 1618 destroyed valuable documents carrying back the history of the manufacture to A. D. 712; the records now in existence go back only to the 12th century, which, early as it is, must still be regarded as late in the history of Erzberg.

"The pig-iron made from this ore is refined in small open hearths with charcoal, and it is found in Styria as elsewhere, that the steel made by the modern process does not compare for combined hardness, tenacity and readiness to weld, with metal made by the older, more tedious and more costly process. Such methods have in modern times almost disappeared, and only in countries like Styria, where vast forests supply charcoal, running water supplies power, and rich, pure ores offer special facilities, can such processes survive."

James M. McDonald, superintendent of the Phœnix Bridge Works, at Phœnixville, Pa., died on the 10th inst. of pneumonia. He was 44 years of age, and was born in Scotland.

The Mechanical Laboratory of Purdue University.

Our readers will remember that a little less than a year ago Purdue University at Lafayette, Ind., lost by fire the larger part of its mechanical laboratory. The building was a fine one, only just completed, and was occupied by the Departments of Mechanical Engineering, Civil Engineering and Practical Mechanics. It had more than an acre of floor area and was filled with an expensive equipment. The disaster was a trying one. Not only was the property loss apparently irrecoverable, but fear was felt that the uncertainty and delay in restoration would result in a loss of the prestige so honorably won by the university, and a diversion of its student constituency in other directions. In this emergency the wisdom and courage of President Smart were quick to assert themselves. In a few weeks new machinery was running in temporary quarters, and the permanent building was in progress of construction. No work prescribed in the catalog has been omitted from the course of any student.

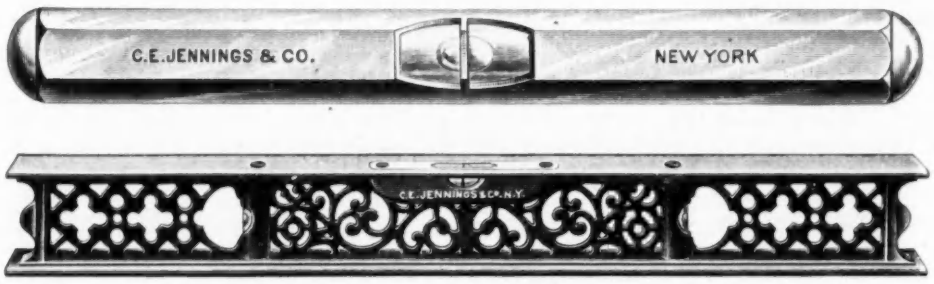
The accompanying plan shows the laboratory as it now stands restored. The portion which was burned included the forge room, machine room and engineering laboratory; also a three-story front containing offices, recitation rooms and drawing rooms. The outlines of the old building have been preserved in the new, but the construction of the front has not yet been undertaken.

All laboratory rooms have been entirely finished and equipped. A room has been added for experimental work with natural gas, and the locomotive testing plant has been provided for in a separate building. Not only has the capacity of the structure been increased but the equipment also in every department has been improved. Space will not permit an enumeration, but the floor plan will serve to show the location of apparatus which is now in place and in daily use.

The arrangement of subjects in the engineering courses at Purdue is such that the wood room and foundry are occupied by freshmen, the machine room and forge room by sophomores, and the engineering laboratory, including the annex for locomotive testing, by juniors and seniors.

By reference to the plan it will be seen that while other lines of work have not been neglected, the equipment of the engineering laboratory is especially complete for work in steam engineering. With the exception of the 10x16 Atlas automatic engine, which supplies power to all parts of the building, the several engines shown are mounted as separate plants, an arrangement by which any chance of interference among different groups of students who may be working with different engines at the same time is avoided. The Buckeye, Straight Line, Baldwin and 7x10 Atlas engines occupy the floor space which before the fire was taken by the plant now in the locomotive testing laboratory. The Baldwin consists of a pair of 9½-inch and 16-inch by 18-inch Vauclain locomotive engines fitted up as a stationary engine. It is supplied with steam from the laboratory boilers and is run under the load of a friction brake.

The locomotive testing plant in the laboratory annex has been much improved. The plan shows Purdue's locomotive "Schenectady" in place, but the arrangement of the plant is such that any locomotive may be received and tested. The engineering laboratory contains 36 steam cylinders, aggregating over 1,500 horse-power.



MACHINISTS' LEVELS.—SEE PAGE 46.

An Instructive Job of Broaching.

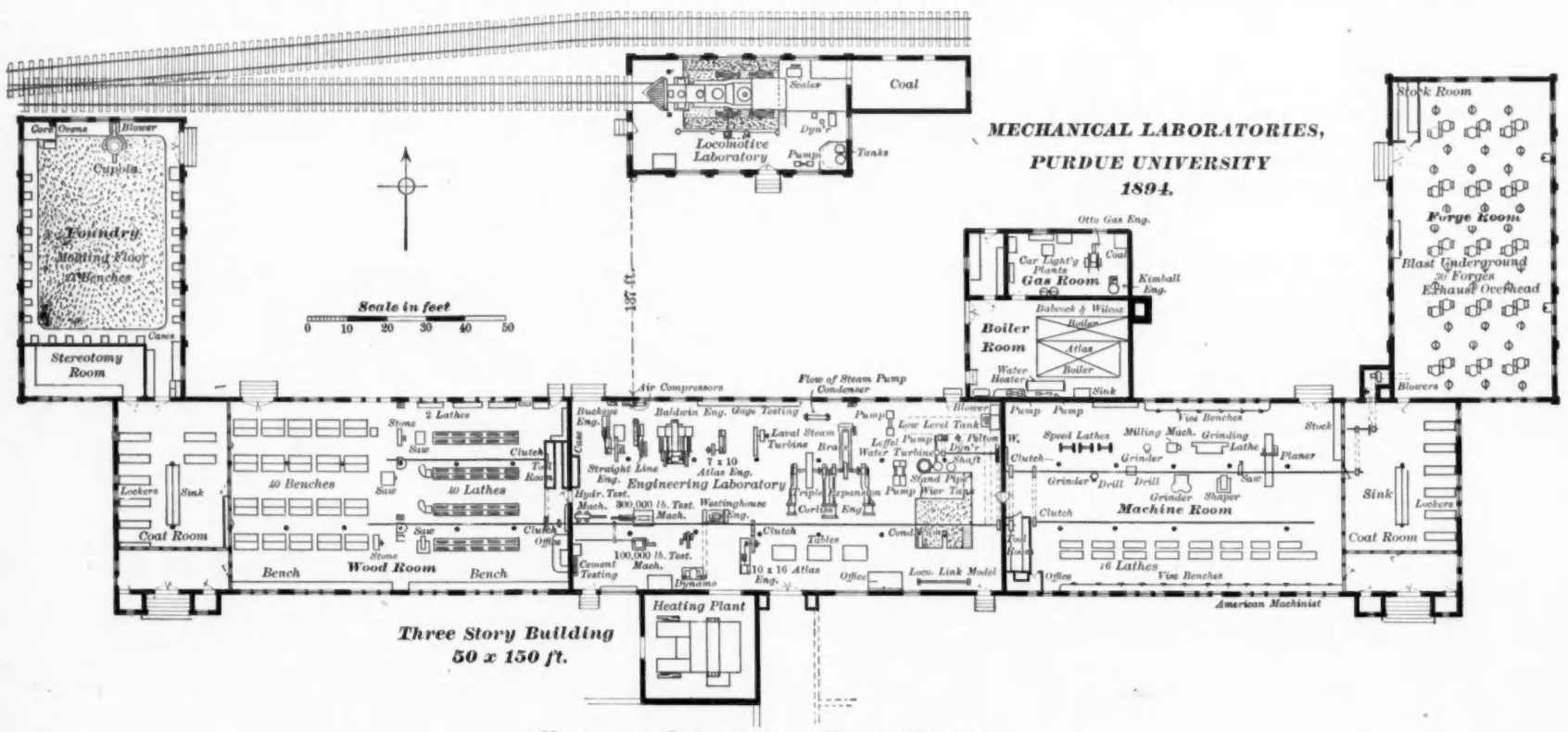
BY HORACE L. ARNOLD.

Somewhere about the middle of 1894 Brown & Sharpe had an application for

Broaching is regarded as among the least desirable of manufactory metal finishing processes, and bears about the same relation to milling that slotting machine work bears to lathe work, hence the hesitation with which this job of tool steel broaching was approached.

Brown & Sharpe have a 60-ton hydraulic press, and it was decided to begin with the simplest operation, a slot 6¼ inches long by ⅛ inch wide by $\frac{9}{16}$ inch deep, calling for a cut 14½ inches long, and for this cut the broach *A*, Fig. 1, was first tried. The 60-ton press proved ample in power to make this cut, but the ram did not for some cause (not explained to me) have a steady rise, although the diagonal cut of the broach gave seemingly the most favorable form of tooth for an equal resistance of chip, and to this unsteady rise of the ram the breaking of the broach teeth at the corners which occurred, was attributed. The broaching gave good results as to size and rapidity of performance, and it was decided to purchase the largest Pratt & Whitney broaching machine (which may be regarded as the standard heavy broaching machine for the gun makers), and go ahead with the job. To the great surprise of every one, however, it was found when the machine had been purchased and put in place, it would not force a broach through a cut which the gauge showed demanded only a pressure of 5 tons on the ram of the hydraulic machine. It was still supposed that the regulation diagonal cut tooth would work all right under the steady action of the crank-driven ram of the broaching press, if only the press could make the cut, which was supposed to be a long way within its capacity.

The stock was, as has been said, tool steel drop forgings, and the allowance for finish was ample. For the sake of speed only one broach was put through the cuts, and as the broaching machine has a stroke of only 6 inches, the broaches could have a cut only 4½ inches long, as the thickest piece was 1¼ inches deep, and hence the chip was probably very much thicker than occurs in the gun maker's practice. The old broaching machines were ponderous aggregations of gearing, one of them in one of the arsenals having, I have heard, a working stroke of 36 inches, and from 18 inches to 24 inches being a common stroke for the arsenal broaching machine rams, used with broaches of corresponding lengths. Mr. F. A. Pratt designed the machine now chiefly used quite a number of years since, and the old long broaches were discarded to meet the 6-inch stroke of the elegant machine offered by Pratt & Whitney, and sectional broaches used having the same total lengths as those



MECHANICAL LABORATORY OF PURDUE UNIVERSITY.

of the old practice, with tits and cavities to match on the ends, so that one short broach could be forced by another successively through the work by succeeding strokes of the machine; this made the whole operation easier, both on the machine and the tool making; the total broach length of, say, 24 inches was far better made in, say, five 5-inch sections than in one piece 28 inches or so in length, and the risks of hardening and straightening the long broaches disappeared. The machine had ample power for all gun-making cuts put on it, and gave great satisfaction, and I cannot now understand how a hydraulic ram pressure of 5 tons could make a cut which this Pratt & Whitney machine refused to take. Perhaps the successive short jumps of the hydraulic ram acted like hammer blows, but, be that as it may, the fact remains that the broaching machine would not do the work, and something had to be done to help it.

Fig. 2 shows the gearing as originally made, and Fig. 3 shows the Brown & Sharpe additions; the same fly wheel, about 477 pounds weight, was retained, and another 3 to 1 reduction with 3 d. p. gears introduced, making the gearing ratio, which had been 15 to 1, now 45 to 1. This drove the broaches, but did not keep them from breaking, as had been expected, though the power of the machine was now so much increased that it would put cuts through which the 60-ton hydraulic press would not stir at all, and put them through easily.

How it happens that the Pratt & Whitney broaching press should prove to have ample strength in the crank wrists and connecting rods to do 3 times the work they were intended for, and how this increase of gearing ratio from 15 to 1 to 45 to 1 should increase the effect on the ram from 5 tons to 75 tons, is not quite clear. The strength of the machine is not so surprising, as the common safety factors of 4, 5, or 6, would still leave a margin after the threefold increase, but how this less than threefold increase of fly-wheel revolutions and belt speed should work a fifteenfold increase in the effective force available for work on the ram is not at all obvious. Yet there is no room for doubt that 5 tons on the hydraulic ram made cuts the original machine could not make, and that the machine can now make cuts that the 60-ton hydraulic press cannot stir.

But the breakages still continued, no matter what shapes were given to the diagonal broach teeth, as shown in *B*, *C* and *F*, Fig. 1. *B* is an ordinary gun maker's form of tooth which I have seen successfully used in a job heavier, I should say, than the long slot in this job, with perfect success, but I believe the broach was about 24 long, all its sections taken together, which probably accounts for its endurance.

It was then decided to try straight teeth, and the very closely spaced straight cut shown at *G*, Fig. 1, was made and given a thorough test, which it endured without breaking or showing any sign of hard work. This fine tooth gave a very smooth, nice finish to the broached surface, but was not coarse enough to permit ready grinding on the face, consequently, to give length of tooth for grinding, the much wider spacing shown in Fig. 4 was adopted, and used with entire satisfaction. None of the straight cut broaches have ever shown the smallest breakage.

The broaches for two of the "hooks" are shown in Fig. 5, with the "hooks" in front of the broach. The large hook broached outline is shown in Fig. 6. The total length of cut is $7\frac{11}{16}$ inches by $1\frac{1}{4}$ inches deep. This job includes an adjusting screw with a long fluted head, and this head is also grooved at a single stroke of the broaching press by use of the tools shown in Fig. 7. The punch *P* fits the die *D*, Fig. 7, and the screw is dropped into the guide *G* in Fig. 8, which shows these head fluting or grooving tools in place in the machine, with a screw head in the guide, ready for the stroke of the press.

Very full illustrations of this work are given, as the various processes are executed at much less cost than was first supposed possible by the best tools, and the whole outfit gives by far the best example of the art of broaching in general which I have ever seen.

Fig. 9 shows a "hook" in place in its fixture on the press, ready for the broaching stroke. Fig. 10 shows the slotting fixture and slotting broach in the press, with work in place. Fig. 11 is a general view of the

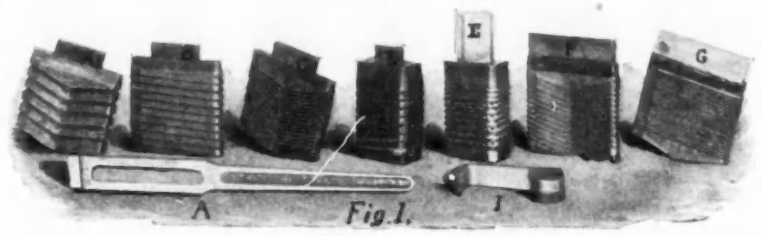


Fig. 1.

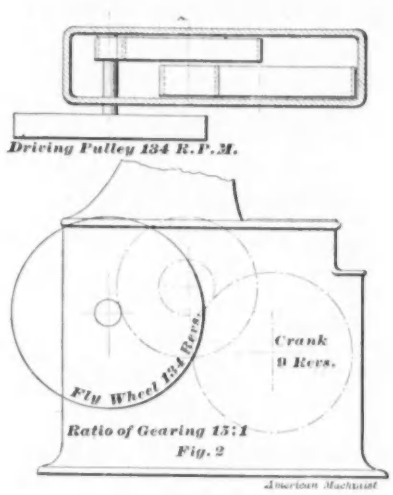


Fig. 2

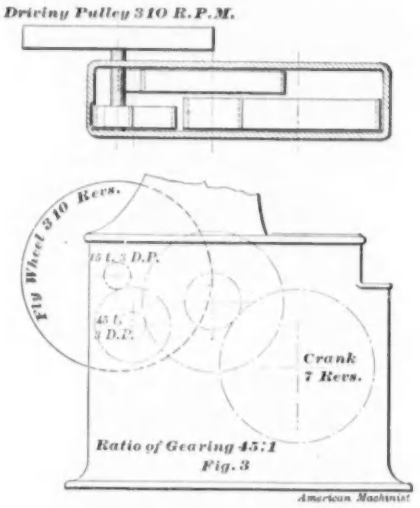


Fig. 3

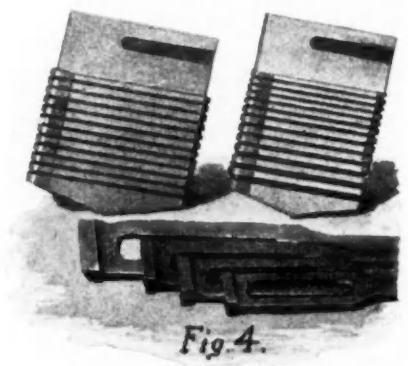


Fig. 4.

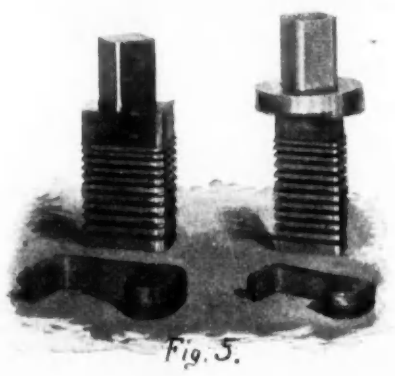


Fig. 5.

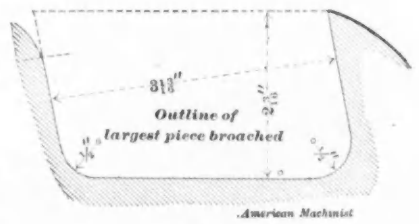


Fig. 6

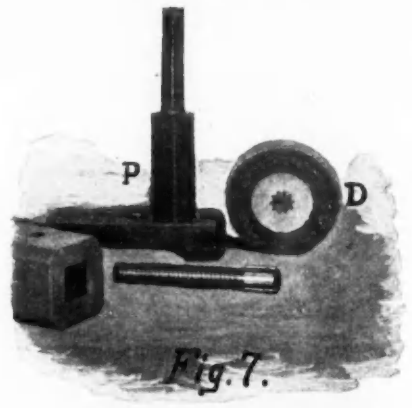


Fig. 7.

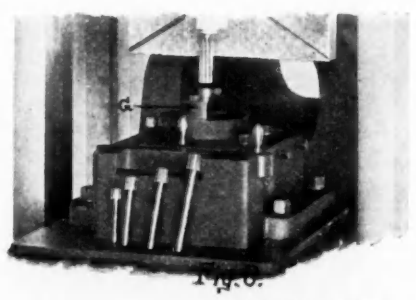


Fig. 8.

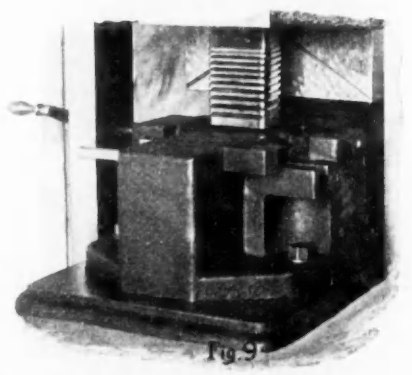


Fig. 9.

AN INSTRUCTIVE JOB OF BROACHING.

machine, with the complete lot of tools and fixtures.

As will be noted, all of these cuts could have been milled; if milled the cost of tools would have been greater, and the cost of work done very much greater, as the slowest broaching cuts are made one cut per minute, and the quickest, seven cuts, or pieces finished, per minute. I do not know of any other instance of a flat surface of tool steel $7\frac{11}{16}'' \times 1\frac{1}{4}'' = 9\frac{9}{16}$ square inches area finished to a good surface in so short a time as $\frac{1}{3}$ of $\frac{1}{7}$ of 1 minute $= 4\frac{2}{7}$ seconds, actual time of work.

The quality of the work is fair. As the finishing is done at one short stroke of the press, there is only a very limited tool travel over the surface, and the surface and gauging are by no means equal to the best gun work; but they are very good, about equal to a very good single cut with a mill, and the work gauges quite sufficiently close for the job. The first cuts were made on annealed stock, and gave a slightly torn surface; unannealed stock was tried, and gave a much smoother surface, and was seemingly easier on the machine than the soft stock, which is another point contrary to general practice and experience.

The lubrication was soda water, soda water and lard oil, and lard oil alone. Lard oil alone gave the best results.

As to the power of the machine as sent out by Pratt & Whitney, the 4-inch belt alone should give, at a pull of 65 pounds per inch of width, and 134 revolutions of 36-inch fly-wheel, about 10 horse-power. The fly-wheel weight of rim is about 477 pounds, which would give at 134 revolutions and a vertical radius of $15\frac{3}{4}$ inches about 532,650 foot-pounds of stored energy to assist the constant belt pull, which is about 10 horse-power, as above stated.

The highest speed of crank-driven ram (3 inches = crank radius) at 9 strokes per minute is about 14.14 feet per minute, and a pressure of 5 tons moving at 14.14 feet per minute $= 4\frac{3}{10}$ horse-power nearly.

This would make the friction of the machine over 6 horse-power, not counting the fly-wheel effect at all. The machine was built on Monroe Stannard's floor, and was built by Pratt & Whitney for Brown & Sharpe, all of which means that it was as well built as possible.

Some elaborate experiments made in 1894 in the interests of direct driving as opposed to geared driving for electric propulsion claimed a loss of 20 per cent. of power for every transmission by gearing, the gearing and journals all of the best workmanship—this would not cause a loss nearly great enough to make the machine stop with a resistance of only 5 tons on the crank, and it is a far larger loss than is generally believed due to transmission by well-finished cut gears.

To make the statement of Brown & Sharpe correct, however, a far larger loss by friction than hitherto indicated must be assumed, and this friction must be assumed to have been constant at the low and high fly-wheel speeds.

The increase of fly-wheel speed, and decrease of crank speed by one course of reasoning may be held to have increased the power of the machine 3.8 times; possibly Brown & Sharpe assumed that as the 60-ton hydraulic press would not make a cut which the altered press would make, then the altered press could deliver 75 tons of useful effect on the ram, when, in fact, it may have delivered no more than, say, 61 tons.

Taking these figures and putting x = constant friction, and P = power delivered to machine at 134 fly-wheel revolutions, would give 3.8 P as effectiveness of machine at 310 revolutions; then (as 5 tons resistance on the ram stopped the slow fly-wheel),

$$\begin{aligned} 5 + x &= P \\ 75 + x &= 3.8\ P \\ x &= P - 5 \\ x &= 3.8\ P - 75 \\ P &= 25 \\ x &= 20, \end{aligned}$$

thus making the friction equal $\frac{4}{5}$ the total power delivered to the machine in the first instance at the low fly-wheel speed. I need hardly say that I do not believe there was any such loss by friction, and it is not to be supposed that the friction was the same after another change of gear had been added, and there was the possibility of moving under 3.8 times the first crank-shaft load.

The grand trouble with all figures on machine tool effects is that the actual conditions can never be known except in cases of absolutely identical duplication, and even then there may be such hidden differences in material supposed to be the same as to make two successive shop experiments *seem* to contradict each other absolutely.

This job shows, if surface indications can be relied upon, that

(1) Broaching is many times cheaper than milling, and should, therefore, be the first resort instead of the last.

(2) It is a mistake to use diagonal lines of broach teeth, although diagonal broach teeth are the invariable practice so far as I ever saw.

(3) Hard stock broaches more easily than soft stock, though soft stock shears more readily than hard stock (sometimes).

(4) That the friction of a broaching ma-

chine is nearly constant, no matter how much work is put on the ram.

(5) That a degree of accuracy quite sufficient for ordinary work may be reached by the passage of a single broach less than 5 inches long, over a surface 1¼ inches wide, where drop forgings are the rough stock, and hence that the long broaches hitherto used (either in one piece, or, as in the common gun maker's practice, in sections, with tits and cavities to match on the ends, so that the sections can follow each other, each pushing its predecessor out of the hole in process of finishing) need not be used, except where extreme accuracy of gauging is required.

(6) Where either broaches or mills may be used, the broaching tools, broaches and fixtures cost far less than mills and fixtures, and broaching machines for a given output cost far less than milling machines for the same work, and take up much less room in the shop.

I am far from asserting that these conclusions are certainly correct; they are, in the points of cost, efficiency and shop room, certainly correct for *this job*, and hence worthy of the most serious consideration in all similar operations.

The following letter from Brown & Sharpe would seem to show conclusively that there is no mistake as to the increase of power obtained:

Mr. Horace L. Arnold,

Dear Sir—Yours of the 1st inst. received. Relative to speed of hydraulic press. At the time we were broaching the large lever, the speed was 3 inches per minute. Our method for determining the comparative power of broaching with hydraulic press was as follows:

When we started work we fitted the hydraulic press with broaches for the largest lever, also fixtures, etc. The pressure registered on gauge was 5 tons; to force the broach through the lever it was impossible to get the broaching press to do the work without repeated stopping and starting the friction which drives the slide, so in our judgment we did not have the pressure on slide given out with hydraulic press.

Again, it occurred fortunately that we had a job come into the shop to remove a 2-inch shaft from a hardened steel roll which had been secured on shaft by shrinking. It was placed in press (and as you are familiar with press gauge), and pressure applied to end of shaft until the pointer went beyond the 60-ton gauge pressure, and continued on until same reached the zero pin on dial. This would give 80 tons if dial had been graduated, but at the same time water was leaking through all joints in pump, etc. We then removed the work, and placed in broaching press (you will understand, of course, the hydraulic press had not started the shaft a particle), and started same without a quiver or flap of the belt. The shaft started from roll with an exceedingly loud report, in fact, equal, if not greater, than a discharge of a heavy field piece; others stated that we certainly had over a hundred tons pressure in power of press when it did the work with apparently so little power used.

Your last question, relative to number of pieces that can be broached per minute, was answered in our letter of yesterday.

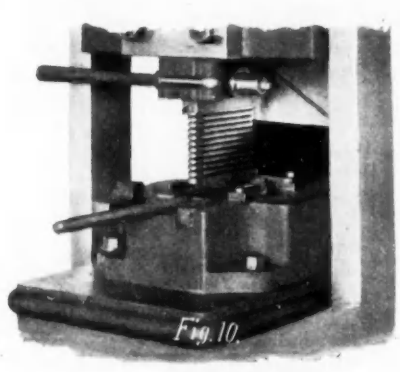
Yours truly,

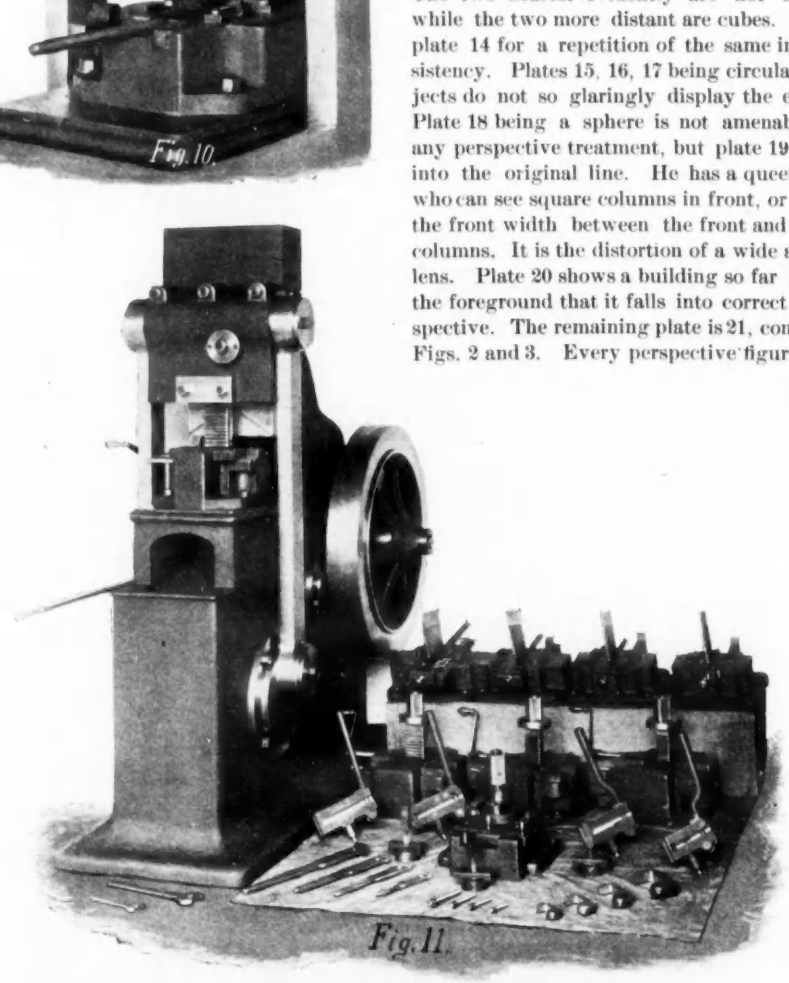
Brown & Sharpe Mfg. Co.,

Suppose, however, that this forcing out job had been set in the broaching press so that the crank-driven ram reached the beginning of the last quarter-inch of its 6-inch down stroke, before it touched the shaft which was forced out of the roll. In this case the machine would have given a blow which could (and did, evidently) start the shaft, which the possible 80-ton dead load of the hydraulic ram failed to stir. But this is far from showing that the press could overcome a uniform crank resistance of 80 tons, or even 50 tons throughout the whole of its 6-inch down stroke. The loud report which announced the starting of the shaft in the shank on roll is good evidence that the crank effect was very nearly up to the limit of the strength of the connecting rods, and that the whole structure yielded before the shaft started, and moved rapidly back to the normal when the shaft started out of the roll. While this described method of estimating the relative extreme effects of the hydraulic press, and the crank broaching press makes the heavy pressure estimate less incomprehensible, it does not explain the original 5-ton limit of the broaching press. I do not understand that at all. I have never seen the effectiveness of the large Pratt & Whitney broaching machine measured, but I am confident I am not alone in believing it more than equal to a 5-ton crank resistance throughout an entire 6-inch down stroke.

New Machinists' Levels.

We present, on page 44, engravings of two forms of spirit levels especially adapted to machinists' use. The first of these is intended to be carried in the pocket if desired, the engraving being full size of the No. 5





An Instructive Job of Broaching.

level, which is $\frac{7}{16}$ inch thick and 5 inches long. The tube is made of an alloy, nicely finished and nickel plated, the surface upon which it stands when in use being ground true, and the glass permanently set true with it.

The second engraving is of a larger level with iron frame, which has two glasses for plumbing as well, and all three glasses are permanently and correctly set, no adjustments being provided. The frame is very neat and light, and is well finished and japanned.

The pocket level is made in five sizes, from 2½ inches to 5 inches long, and the others in three sizes, from 12 inches to 24 inches long, all the sizes of the latter being 2 inches wide. They are manufactured by C. E. Jennings & Co., 79 Reade street, New York.

Edwin S. Lenox died suddenly of heart disease at Worcester, Mass., on the 7th inst. Mr. Lenox was educated as a physician, but developed inventive genius, and invented a machine for making the fastener for wire bale ties. He had been with the Washburn & Moen Mfg. Co. since 1876.

LETTERS FROM PRACTICAL MEN.

No Mathematics in Perspective.

Editor American Machinist:

In your issue for December 6th you advise the seeker after perspective to take up Davies' "Shades Shadows and Perspective." You will consider me an iconoclast maybe, but I wish to say that Professor Davies had not much more idea of perspective than a horse, and the work above, so far as it relates to perspective, is entirely misleading Professor Davies was a mathematician. He fell into the error of supposing perspective to be a part of mathematic science, and treated it from a mathematical standpoint. Nothing could be more erroneous. Perspective has not a single mathematical point. It is something which concerns the eye alone. When a picture of a house looks as the house looks it is in correct perspective when it does not look like the house it is not correct in perspective. That is the whole story and brings me squarely in front of Professor Davies, whose book is before me. Look at plate 12. At the left hand is the perspective figure of a cube, shown also in plan and elevation. I do not think anybody will be hardy enough to say that that *looks* like a cube. Manifestly it is at least twice as long from front to rear as from side to side. Look at plate 13, there are four cubes. The two nearest evidently are not cubes while the two more distant are cubes. Try plate 14 for a repetition of the same inconsistency. Plates 15, 16, 17 being circular objects do not so glaringly display the error. Plate 18 being a sphere is not amenable to any perspective treatment, but plate 19 falls into the original line. He has a queer eye who can see square columns in front, or only the front width between the front and rear columns. It is the distortion of a wide angle lens. Plate 20 shows a building so far from the foreground that it falls into correct perspective. The remaining plate is 21, contrast Figs. 2 and 3. Every perspective figure excepting 18 and 19 is drawn upon the principle of Fig. 2, plate 21; and Fig. 3, plate 21, plate 20 are the only ones in the whole book which correctly represent to the eye the object depicted.

It is not admissible for a moment that Professor Davies could fall into such error if he correctly understood the subject he was treating of. It is quite manifest he was no artist or his eye would have instructed him. Compare plate 19 with the figures of an almost identical colonnade in "Chapman's Drawing Book," pages 198, 199 and 200.

The truth of the matter is, some rules which have a geometrical look have been adopted merely as mechanical helps. Within narrow limits these rules serve a useful purpose because the distortion produced is too slight to be noticeable. From the point occupied by the eye the whole picture delineated must fall within an angle of about 15 degrees. If this angle is laid down upon paper it will be found to be quite a narrow field. If the so-called rules of perspective are followed into the foreground outside the 15 degrees limit, the distortion will become quickly apparent. This is what Professor Davies did unconsciously. The place of the eye is so close to the picture plane that the angle which would embrace the nearest cubes would be 100 degrees or thereabouts while the most distant cubes might be embraced within an angle of, say, 20 degrees or thereabout.

Dismiss the thought that there is any real mathematics in perspective.

R. D. O. Smith.

[Probably if we consider only the kind of perspective which Mr. Smith has in mind then there is, as he says, no mathematics in perspective, but mathematics has been applied to perspective, or something which passes for perspective, and helps to enable those who are not born artists to make use of perspective.—Ed.]

Piecework in Machine Shops—The Real Duties of a Foreman.

Editor American Machinist:

Will you permit a few more words or thoughts to what has been said lately in your paper on the subject of "Piecework in Machine Shops"? My own opinion is that piecework pays in machine shops, and this opinion is based on practical experience and observation in many of the shops of this country. It has no tendency to lower the standard of work; I am satisfied that it will improve the work. There are many of our wise men who say piecework does lower the standard of work, and they prefer to pay their workmen moderate wages, and have them work by the day. Once in a while we find a man who has his house or shop built by the day in order to get a good job done. However, I think I am correct in saying that 99 per cent. of the special work as well as the regular that is ordered from machine shops, the buyer gets a price on before ordering. Now, if this is a good thing to do, why is it not a good thing for the manufacturer to put a price on his work before having the workmen do it? I have always believed that any such scheme in the machine shop must be figured to work beneficially to all concerned. I believe one of the objects of piecework which the employer considers is to get the greatest amount of work for the least possible cost. The workman's object is to earn the greatest amount of money in the least possible time.

Piecework in our shops is like many other things when not properly managed—it fails to work well. Foremen have a great deal to do with this system, and oftentimes they are the cause of its failure.

The proprietor or superintendent starts out for reform in the shops. He gets the foreman; they all talk the matter over, and it is decided to try the piecework system. Now, I am sorry to say in too many of our shops the heads are not practical men, and so the foreman has to shoulder the matter.

Very soon the foreman finds that piecework takes a great deal of his time, and also he finds a lot of his old hands that have known him for years have all sorts of objections to the piecework system. The foreman is now about ready to give it up and fall back into the old ruts.

Now, let us examine into the condition of things in this shop. First, we find the foreman has no time to attend to the piecework system, and second, we also find he has no time to attend to the real duties of a foreman. He has a lot of clerical work to do the first thing every morning, such as trying to keep time, weighing stock, ordering castings, giving out the supplies, such as waste, oil, and files, and a hundred of such little things. Some workman comes along for information regarding his job (as the only time he ever gets any is when he asks for it). The foreman says you must wait awhile—I have got to get out a casting to-day, and I must find the pattern. Now we find him in the pattern shop, where there is a horrible system of keeping patterns; here he spends one and a half hours looking for a pattern that would only cost 15 cents to make new, and so he goes on in this way about three-quarters of the day. Allow me to suggest that it would pay in such a shop to employ

a good active young man to do all this kind of work, and allow the foreman to get out his work with the least possible expenditure, time and cost. In our days the buyer requires machinery that he orders to be quite a little different from what he ordered a few years ago. He wants things stronger, rounder, longer, quieter running, oil holes big enough to let oil in and air out. Now, I think a little of this kind of treatment would do the foreman good. I have the greatest respect for foremen—they are not all to blame for the above described condition of things, and I would not care to have your readers think that I was so unfortunate as to always run across this kind of shop. There are lots of shops conducted much differently, but there are a few about as described. We have, perhaps, all heard the saying of the fellow that said he would get rich if he had to pull old nails out of old boards; the other fellow said he would get rich, but not in that way. H. S. C.

Standard Catalogs.

Editor American Machinist:

No bad practice or fault in our business methods ever gets remedied until it is brought before the public.

Having a great many catalogs on different subjects to keep in order, and having to use them very often for reference, I have found one great fault with all, that is, lack of uniformity in size, not only between the catalogs of different manufacturers, but between different catalogs of the same manufacturer.

There would be the following advantages in uniformity in the sizes of catalogs: First. They could be kept in order for use and reference much better. Second. All would be on an even footing as far as ease of getting at the catalog is concerned, and the choice of the engineer would depend upon the quality and price of the material set forth in the catalog. This would give fully as much opportunity for original and striking catalogs as now, for only the size would be limited. The writer has frequently thrown a catalog aside for one of another manufacturer who had a more convenient size, the product of both being practically the same. Third. If all catalogs were made uniform in size it would make them cheaper, as in that case the printers would not have to keep so many different sizes of paper. And when they were asked to figure on a job they would not have to stop to see how many words to a page the proposed size would contain, or from what sized paper it would cut. But when given the number of words, number of square inches of cuts, and kind of paper, could give the price at once from previous work.

The writer would suggest the following sizes: Pocket size, 4¼ by 6 inches; shelf size, 6 by 8 inches; plate size, 10 by 12 inches. Another good point would be to print the title on the back whenever the thickness would permit.

This note has been provoked by several years of trying to keep the catalogs I have to use in shape, and I am sure it expresses the feelings of every engineer who has to use catalogs.

H. M. LANE, Consulting Engineer.

La Fayette, Ind.

Why Does a Bicycle Stand Up?

Editor American Machinist:

Mr. Beach's criticism in your issue of December 20th is probably correct. When two wheels are connected by a rigid frame, the free motion is not of the same nature as that of a single wheel; when the wheels lean to one side they have a tendency to move in a circle just as the single wheel has, but the rigid connection prevents such motion, and if the axes of the wheels are parallel the motion will be straight whether the wheels are leaning to one side or stand up straight.

I now wonder how I could overlook a condition so self-evident and feel a strong inclination to "kick myself." I have tried the experiment myself with a bicycle on a smooth floor and found it would move in a straight line even if it was considerably inclined, but as soon as one wheel was lifted off the floor, the other wheel would immediately start on a curved track. This tendency to turn about a vertical axis can also easily be observed when rolling a wheelbarrow. The turning "moment" is of small magnitude, but the effect is nevertheless absolute and certain in the case of a single wheel, for there is no resistance to the turning action. I have used a bicycle every day for years, and I often rode down hill on a good road with my feet off the pedals, and I do not know that I ever had to turn my wheel from one side to another to preserve equilibrium. I am not using a bicycle now, and cannot investigate this matter personally, but I spoke about it to a young man who rides occasionally, and he thinks that when he rides down hill he is doing nothing but keeping his wheel in a straight line. However, if this be the case I am not now able to explain why it is so, and I will take

WHY DOES A BICYCLE STAND UP.

it for granted that Mr. Beach has more experience in bicycle riding than my friend and I.

The question now seems to be, or ought to be, "Why does a bicycle *not* stand up?" A single rolling wheel does stand up as long as it is kept rolling on a reasonably smooth road, but a bicycle does not stand up; the man who rides it must all the time manipulate the steering handle to make it stand up; it does not stand up on its own accord as does a single rolling wheel.

I have in my article of November 29th explained why a single rolling wheel is in dynamical equilibrium, and I think my theory is correct. Why, then, can a bicycle not be made to stand up by dispensing with one of the wheels? Here seems to be room for invention; the trouble is that there would be nothing to keep the machine in balance in the direction of motion, and there is a danger that the invention finally may turn out to be a cross between a flying machine and a unicycle; but it cannot be denied that this subject is worthy of the attention of inventors, if, indeed, it has not been exhausted already. Just think of a wheel rolling right along if only kept in motion, and a quite moderate speed at that, while the lord of creation mounted on a bicycle must be continually working to keep himself from tumbling over. How much nicer would it be if he could take his hands off the handle, smoke a cigar, read the paper, tip his hat to the ladies, etc., without danger of tumbling over? Expert riders can probably do this, but if they do it it is probably not because they like to do it; and then all cannot be experts.

I have been told that there are circus performers who take their bicycle apart and ride on the front wheel only, and that they apparently find no difficulty in keeping the wheel from falling sidewise, and that they can turn any curve they please by throwing their weight to one side or the other, but the difficulty seems to be in keeping the performer from falling in front of or behind the wheel. To obviate this trouble, it seems necessary to have another wheel, and it must have a motion independent of the main wheel, and all or nearly all the weight must be on one wheel, otherwise the action will not be as with a single wheel—one wheel will counteract the action of the other wheel—the bicycle will not stand up. The problem is rather intricate, and after it is solved theoretically correct, there is still the practical part which must be solved. I do not think it is an easy problem; I think the designer will be embarrassed in every direction, and that each stroke of genius will meet an objection, but hope that I may be mistaken. My diagram shows a scheme which *may* work. It will be seen that the center of gravity can be placed directly over the center of the front wheel or at any desired distance to the rear. The seat and front wheel bearings form one rigid structure. The small trailing wheel is supposed to carry very little weight—it will act to some extent like a rudder. It will be seen that it can turn sidewise about a vertical pivot so as to allow the wheels to swing in opposite directions without turning the handle, that is, when the front wheel leans to one side the action caused by contact with the ground will swing it to this side, and this action being, say, ten times stronger than the corresponding action on the trailing wheel, will govern the motion of the bicycle. It is geared like a safety bicycle, and the front wheel can therefore be comparatively small. The small wheel in front is to prevent "headers." I suppose there will be objections to this wheel, but if it is made of rubber and carried by a spring it may work satisfactory in some localities at least. The front standard can, of course, be made slanting, as on an ordinary bicycle, which will facilitate turning. J. BEGTRUP.

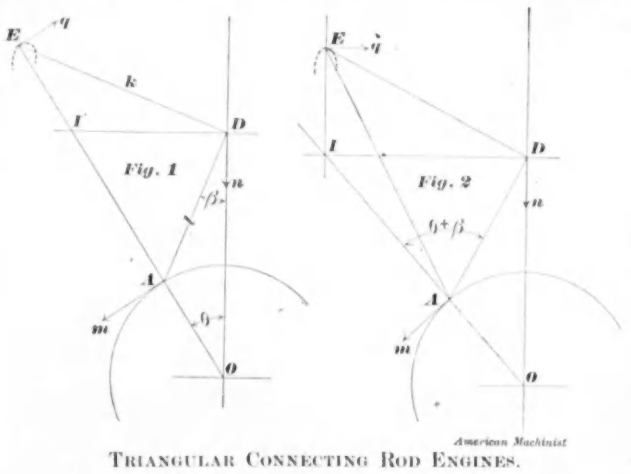
Ridgway, Pa.

Triangular Connecting Rod Engines.

Editor American Machinist:

In the issue of December 27th, there is a very interesting article by "M. E.," on "'Triangular Connecting Rod' Engines," and in the said article there is a statement concerning the limiting positions of the piston rod, and therefore of the stroke of the engine, which I beg leave to correct.

The disputed statement is, that when $O\,A$ and $A\,E$ (Fig. 1) are in line, E is at the superior limit of its motion. Now, at this time, A is moving in the direction $A\,m$, perpendicular to $O\,A$, and D is moving in the direction $D\,n$. Whence the instantaneous axis is at I, at the intersection of $D\,I$, drawn perpendicular to $D\,O$. Therefore, the motion of E is in the direction $E\,q$, perpendicular to $E\,I$ or to $E\,O$, and it is clear



TRIANGULAR CONNECTING ROD ENGINES.

that E has not yet reached its limit of motion in a direction parallel to $D\,O$.

Calling $D\,E$, k $D\,A$, l; the angle $A\,O\,D$, Θ and the angle $A\,D\,O$, β, it may also be readily proved that E has reached the superior limit of its motion when

$$\frac{k}{l} = \text{tan. } \Theta + \text{tan. } \beta;$$

but when $O\,A$ and $A\,E$ are in line,

$$\frac{k}{l} = \text{tan. } E\,A\,D = \text{tan. } (\Theta + \beta),$$

which is manifestly greater than

$$\text{tan. } \Theta + \text{tan. } \beta,$$

and therefore this cannot be the required position of E.

When E is at its true superior limit, I, the intersection of $O\,A$ produced with a perpendicular to $D\,O$ at D, will be vertically under E, as shown in Fig. 2, for then the direction of the motion of E will be perpendicular to $E\,I$ and to $D\,O$.

The inferior limit of the motion is determined in a similar manner.

JOSEPH COTTIER, M. E.

Jersey City, N. J.

The Co-operative Contract System.

Editor American Machinist:

The article by Mr. Richards, on the "Co-operative Contract System," which you published on November 15th, was very interesting to me, and I have watched your columns to see some comment.

It is plain that there must soon be a change from the prevailing method of giving labor its share of production. The method described by Mr. Richards is worthy of a serious discussion which would be interesting alike to owners, managers and employes. It is claimed that this system has a good moral effect on the workmen in that it puts responsibility in their hands without in any way interfering with the independence of the employer. This seems plausible.

There would be difficulty in deciding the relative rates of pay to the men. Of course, the authority to decide this must rest with the firm, which will consider the wishes of the men. It would be easy to decide between the machinists or the men of any other department, but there would be discontent between the trades. Machinists would complain that the molders were rated too high, and *vice versa*. This would be one defect in the system.

I see that this plan would call forth an organization among the men. Their representatives will make a bargain with the firm, and after the price is fixed all will do their best to make a cheap, good job—each department working in accord with the others.

It may not be known to all that the method of pricing work by calculating the area of the finished surfaces, is used in many shops in this country, and saves much dispute. For instance, if a boring-mill hand has a hole to bore that is 4 inches diameter and 6 inches long he considers that he has 24 square inches in it. He expects from 1½ to 2½ cents per inch, depending on the finish. The piecework clerk uses the same rule. The machinist estimates that he should get 48 cents for it. He may have 45 or 50 cents offered him. The same principle is used with all other machine work.

Mr. Richards refers to a system in use at the Baldwin Locomotive Works, as being satisfactory. I have heard a great deal of complaints about their pay, but know it to be very fair in many cases, and it is well known that they turn out a good and cheap machine. Some work they let to petty foremen who share their profits with those under them in an indefinite way. Other work is let directly to the workman. Quick work is secured from each man, but each works against his fellows and each department against the others, thus causing loss to the firm. This is the natural result from any system of individual piecework. The smith leaves too much finish, and the machine hand complains of this. He does as little on the piece as the inspectors will allow, and the vise hand complains that this is unjust to him. In turn, the vise hand skimps his job, and the firm gets poor results, besides losing the time it took the machinist to do what the smith should have done, and the vise hand to repair the neglect of the machinist. The moral effect of this is the very worst. There is continual discontent on the part of every one. I believe the co-operative system will remedy this.

On rough work which is easily examined the paying the workman so much a piece is satisfactory, especially under the premium system as used in some shops, notably the Midvale Steel Works. But in ordinary machine building where many men are employed on one job which cannot well be divided, the system described by Mr. Richards seems very much superior, all things considered

E. G. B.

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☞ *We invite correspondence from practical machinists, engineers, inventors, draftsmen, and all those specially interested in the occupations we represent, on subjects pertaining to machinery.*

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NEW YORK, JANUARY 17, 1895.

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Standard Size Catalogs.

On another page of this issue will be found a letter on the standard catalog question. The reasons given in this letter for the adoption of a standard size of catalog are good ones, and there are other good reasons not given, but we hope no manufacturer will adopt the sizes suggested by Mr. Lane—our reasons for this being much the same as for our hope that no one will invent or suggest a new wire gauge.

So far as we are aware, Mr. Newell Sanders first suggested a definite standard size catalog (6 inches by 9 inches) in a communication published in this paper February 19, 1891, though several of our corrrespondents and we ourselves, editorially, had previously called attention to the great desirability of *some* standard size. In our issue of April 16, 1891, Prof. John E. Sweet indorsed the 6-inch by 9-inch standard advocated by Mr. Sanders, and subsequently called attention to the advantage arising from the fact that this is the size of the publications of the American Society of Mechanical Engineers and of other technical societies, giving some ground perhaps for the erroneous impression that the A. S. M. E. had recommended a standard size of catalog.

Since that time we have repeatedly advocated the adoption of this size, and are gratified to note that it has been adopted by very many manufacturers, a large proportion of the new catalogs now being received at this office being of that size.

But it sometimes happens that for special reasons a catalog *must* be larger or smaller than 6 inches by 9 inches, and where this is the case then one of the standards recommended by the American Railway Master Mechanics' Association should be adopted. A committee of this association was appointed to investigate and report upon a complete schedule of sizes for catalogs, pamphlets, reports, etc., and this committee recommended the 6-inch by 9-inch standard for the medium size of catalog, while for the larger ones they recommended a page just twice as large one way, or 9 inches by 12 inches, and for the smallest size (suitable for the pocket) a page just half the size one way, or 4½ inches by 6 inches.

There are obvious advantages in adopting one or the other of these sizes. In making them if we start with the 9-inch by 12-inch size the paper folds just once more to make the 6 inch by 9-inch size, and again once more to make the 4½-inch by 6-inch size, no waste being involved, while engravings made to go one way on the page of a given size will go the other way on another size larger or smaller, or cuts made for a smaller size will fit side by side two or four to the page in the larger sizes, while for filing and referring to such catalogs there are equal and obvious advantages.

We think that nearly all machinery catalogs can be and should be 6 inches by 9 inches, and that the reasons for any given manufacturer adopting that size are constantly growing stronger as its adoption becomes more nearly universal; but where for any reason this size cannot be adopted then either 9 inches by 12 inches or 4½ inches by 6 inches should be adopted.

Another point which we think is important is to print at the top of the front cover the legend, "Standard Catalog, 6 inches by 9 inches," or whatever size is adopted, this being in the interest of the manufacturer who issues the catalog, enabling those who receive it to instantly recognize it as standard, and also constantly reminding those of them who themselves issue catalogs that there is a standard for them and that they had better conform to it and thus do their part toward the establishment of the millennium.

A Large Salary—The Alleged Jealousy of Wealth.

The most liberal figures in the way of a salary that we remember having heard of are those agreed upon between the late Jay Gould and his son George. The latter agreed to devote his entire time to the management of his father's business, and not to engage in any business for himself, and for this he was to receive $500,000 a year, and has been allowed $6,000,000 for twelve years' service at the rate named.

When these figures are compared with the amounts earned by most of the greatest men and greatest benefactors of humanity that ever lived—when they are compared with the amounts earned by the great creative geniuses of the world—men whose work has been simply of incalculable benefit to their own and all succeeding generations, one becomes somewhat dazed. At this rate the young man has been earning $1,565 a day for every working day, making no allowances for holidays, or being docked for arriving at the office a little late.

In recent times many a manufacturer carrying on a really useful business has considered himself lucky to come out at the end of the year with $1,500 ahead, and Mr. Gould's daily wages amounted to more than the usual life's savings of an industrious and economical workingman.

The fortune left by Jay Gould is now officially announced to be $80,000,000, and, supposing he made an average of 4 per cent. on this, the income would be $3,200,000 annually, which, as will be seen, left enough for the elder Gould to live on very comfortably, even after paying the salary named.

We call attention to these matters, not because we wish to add to the alleged "jealousy of wealth," for we believe there is no jealousy of wealth worth talking much about, but we think some discrimination should be made between workingmen, manufacturers and business men, who call attention to unjust conditions, and the comparatively few blatant howlers who declaim against all wealth, and yawp about the injustice and wrong of anyone's owning anything.

Neither do we mean to criticise young Gould, who, we understand, is in all respects a very exemplary young man, possessing very great business ability, but it will be hard to convince the average machinist, for instance, whether he be an employer or an employe, that everything is exactly as it should be when such very great inequalities can exist.

A Foreman's Duties.

In another part of this issue we publish a letter from a man who has been through all the grades of service in a machine shop from apprentice to superintendent, and who therefore speaks from experience when he calls attention to the fact that there are many foremen of machine shops who put in a large share of their time in doing things which they usually cannot do as well as a ten-to-fifteen-dollar-a-week-clerk, and are thus forced to let go undone, things of the utmost importance which nobody but the foreman himself can possibly do.

The letter may easily prove a very valuable pointer for many shop proprietors and superintendents who allow the time of their foremen to be taken up by routine and petty affairs—time which should be spent in thinking, planning work, devising improved methods, or helping the workmen and apprentices over difficult places; in short, doing those things for which a foreman ought to be employed, and by doing which he can make himself valuable and keep the shop from getting into that chaotic condition which precludes efficiency, and always results from the absence of a directing intelligence.

The Disappearing Gun carriages.

To judge from the action of the War Department in awarding the contracts for the new disappearing carriages for coast defense guns, one would think that war had been already declared against us or certainly would be within a few days. In order to facilitate delivery orders for four carriages have been placed with the Pond Machine Tool Co., and a like number to the Bethlehem Steel Co.

There is an evident advantage in having a number of establishments in the country that have had experience in constructing such things, and would consequently be prepared to push them rapidly in case of need, and possibly this is the real reason for dividing the lot

S. T. J. Byam.

It is with regret that we record the recent death of one of the best known among the expert mechanics engaged in the manufacture of watches, and other fine interchangeable mechanisms.

Mr. Byam was for many years in responsible positions with the American Waltham Watch Co., and the Waterbury Watch Co., and on the reorganization of the Trenton Watch Co., in 1885, was made superintendent of that concern.

The Lancashire Watch Co., of Prescott, England, having adopted American machinery, Mr. Byam was selected as the person most competent to place the new departure upon a satisfactory working basis, and relinquished his position with the Trenton Co. to take charge at the English works, but did not like living there, and soon returned to this country.

At the time of his death, Mr. Byam was connected with the Pratt & Whitney Co., as manager of their New York City office.

He was noted for his considerate regard for his employes, and the news of his death will be received with concern by a wide circle of friends.

QUESTIONS AND ANSWERS.

Questions of general interest relating to subjects discussed in our columns will receive attention in this department. The writer's name and address should always accompany the question. Neither correct initials nor location will be published when there is a request to that effect. If questions are enclosed with a business communication, they should be written on a separate sheet. We cannot undertake to answer questions in "next issue." This department is usually crowded, and questions must wait their turn to be answered. Neither can we undertake to solve mechanical or engineering problems, and send answers by mail.

(23) E. J., Norwood, R. I., writes: Kindly state if there is any book published treating on brazing, hard and soft soldering, flux and the general treatment of work of this character; if so, please name title of book; publishers' name and price. *A.*—We do not know of a book that treats specially on this class of work; you will, however, find considerable of the information you seek in the book entitled "Spon's Mechanics' Own Book;" this book treats on many other subjects. It is published by Spon & Chamberlain, 12 Cortlandt Street, New York. Price, $2.50.

(24) F. G., Lynn, Mass., writes: Please let me know from whom I can get a set of castings for a 3 horse-power stationary engine. *A.*—You can obtain these from T. Shriver & Co., 333 East Fifty-sixth street, New York, or from A. L. Weed & Co., 106 Liberty street, New York. 2. I have a boy who has been at the machinist trade about 2½ years; I would like you to name some good books for him to study. *A.*—It is difficult to recommend suitable books to any one without knowing what advancement he has made in a general education. Under these circumstances it will be best for you to read answer to Question 539, in our issue of November 22, 1894, in which a course of study for beginners is indicated, and the titles of suitable books given.

(25) C. D. A., Cleveland, Ohio, asks: What should be the relative sizes of steam and water cylinders for steam pumps? *A.*—The sizes depend altogether on the service required. Where there is a head or pressure against the pump piston the steam piston must be large enough not only to balance the resistance due to head pressure, friction, etc., but to speed up to a proper velocity. While calculations can be made to determine the proper sizes experience is the best guide, as there are many things that can hardly be enumerated that affect the satisfactory working of a pump. The catalogs of first-class pumpmakers will furnish you the data you require, which can be relied upon as embracing the best practice. You are wrong as regards the effect of enlarging the suction pipe, as the less velocity of inlet water would generally make the pump more efficient. If, however, the pump was working against too great a head for the relative sizes of steam and water cylinders—choking off the supply by means of a small pipe, or otherwise, would decrease the work of delivery—and so enable the pump to make more strokes than it otherwise could.

(26) W. A. E., Charlotte, N. C., writes: Please give me a rule for finding the diameter of a gear when the number of teeth and pitch are given. *A.*—If the circular pitch is given, then multiply the number of teeth by this pitch, and divide the product by 3.1416, the result will be the diameter of the pitch circle. Or you may use the following rule: Since dividing by 3.1416 is the same as multiplying by $\frac{1}{3.1416} = .3183$, we have: multiply the number of teeth by the circular pitch and by .3183, the result will be the diameter of the pitch circle. To find the diameter outside of the teeth, add two teeth to the given number of teeth in the wheel, and multiply the sum by the circular pitch and by .3183, the result will be the diameter of the outside of the teeth, or the diameter of the addendum circle. This is an empirical rule, it is used by many mechanics. When the diametral pitch is given, that is, the number of teeth to 1 inch of diameter of pitch circle, we have the following rules: Divide the number of teeth in a gear by the diametral pitch, the result will be the diameter of the pitch circle. 2. Add two to the number of teeth in the wheel, and divide the sum by the diametral pitch, the result will be the whole diameter of the gear, or the diameter of the addendum circle.

(27) Torsion, Battle Creek, Mich., writes: Kindly answer the following: 1. Why is a connecting rod made larger at the crank end than at the crosshead end? *A.*—Connecting rods are made large at the crank end for the purpose of overcoming the resistance due to friction, which acts with a greater leverage on the crank-pin than on the crosshead pin, the latter pin being smaller in diameter than the former. The stresses due to the inertia of the rod also call for a larger section of the rod at the crank-pin end than at the crosshead end. 2. Should a shaft be made larger in the center than at the ends for uniform torsional strength? If so, why? *A.*—No; provided the shaft is properly supported. If the shaft is comparatively long, and supported at the ends only, the section at the center will have to be greater than at the ends, so as to resist the transverse forces due to the weight of the shaft. 3. Would a shaft of uniform section twist apart in the center rather than near the ends when the twisting force is applied at the ends? *A.*—No; provided there are no transverse forces acting at the center. 4. What is the best section for torsional stiffness? *A.*—Circular. 5. Do you know of any envelopes specially adapted to receive clippings? What is the size of these envelopes? I would like them about 6x8 inches to take a page of the AMERICAN MACHINIST folded twice. *A.*—There are envelopes made for this purpose; their size varies. It seems to us that you should not have much trouble to obtain the size you need.

(28) C. S., Hamilton, Ohio, writes: Kindly publish method of finding the horse-power necessary to run a fly-wheel of the following dimensions: Mean diameter of rim 63 inches, weight of rim 2,000 pounds, weight of hub and arms 400 pounds, rim speed 3,000 feet per minute, diameter of pulley on fly-wheel shaft 30 inches. Friction in the machine is not to be taken into consideration. *A.*—In running the fly-wheel at a uniform rate of speed, the only resistances to be overcome are friction and that of the air; the latter is generally neglected in computations of this kind, and if now friction is also to be left out of consideration, or if there is no friction, then the fly-wheel will not require any power to drive it, because, when running at a uniform rate of speed, there is no energy being stored up in the wheel, and consequently no power will be required to run it, and if there is no friction, there is no resistance, and consequently no expenditure of power. If, however, the rate of speed is not uniform, the fly-wheel gives out stored-up energy during the time that the speed is being decreased, and in increasing its velocity up to the normal speed, energy is being stored up in the fly-wheel, and this requires the expenditure of power; to compute this power, the resistance due to friction may be neglected. For computing the stored-up energy in a fly-wheel when it has attained a uniform velocity, we have the following formula:

$$e = \frac{w \times v^2}{2 \times g},$$

in which e denotes the stored-up energy in foot-pounds, w = weight of rim in pounds, v = linear velocity in feet per second of the rim at its radius of inertia, and g = acceleration in feet per second, due to gravity, which is frequently taken at 32.2 feet per second. We shall assume that the given speed of 3,000 feet per minute is that of the radius of inertia, or of a point nearly in the center of the rim, this gives us a velocity of $\frac{3,000}{60} = 50$ feet per second. Now, substituting in the formula for the letters their values, we have,

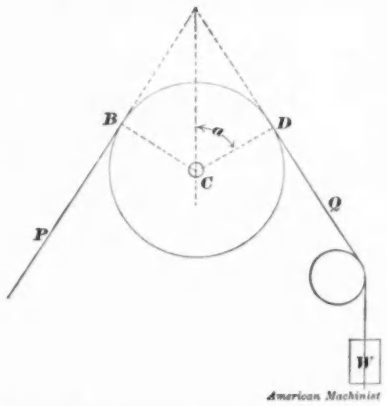
$$e = \frac{2,000 \times 50^2}{2 \times 32.2} = 77,639 \text{ foot-pounds.}$$

If this velocity has been attained in 90 seconds, or 1.5 minutes after starting from rest, then the power expended in merely accelerating the fly-wheel is,

$$\frac{77,639}{33,000 \times 1.5} = 1.56 \text{ horse-power.}$$

In the above the weight of hub and arms of fly-wheel has been neglected.

(29) B. T. C., Lowell, Mass., writes: Kindly inform me how an alloy of aluminum may be made that will be light, rigid and elastic. I desire to get castings of such a metal, and saw an article on aluminum and its uses in your paper, Vol. XV., No. 44, which states that titanium and chromium can easily be alloyed with aluminum, but does not state the method used or the percentage of alloys. Any information that you can give me will be appreciated. *A.*—It is difficult to obtain the percentage of titanium used in this alloy, as manufacturers do not care to say much about it. It seems to us, however, that aluminum bronze should answer your purpose. For this alloy 10 per cent. of aluminum is added to the copper. With small bars cast in sand, perhaps the best physical results obtained are: Elastic limit, 70,000 pounds per square inch; tensile strength, 95,000 per square inch, with about 10 per cent. elongation; its color is bright golden. The metal keeps its polish in the air, may be easily engraved, and can be soldered with hard solder. For preparing the bronze the following directions are given: Melt the copper in a plumbago crucible, and heat it somewhat hotter than its melting point. When quite fluid, and the surface clean, sticks of aluminum of a suitable size are taken in tongs and pushed down under the surface, thus protecting the aluminum from oxidation. The first effect is necessarily to chill the copper more or less in contact with the aluminum, but if the copper was at a good heat to start with, the chilled part is speedily dissolved, and the aluminum attacked. The chemical action of the aluminum is then shown by a rise of temperature, which may even reach a white heat. Considerable commotion may take place at first, but this gradually subsides. When the required aluminum has been introduced, the bronze is let stand for a few minutes, and then well stirred, taking care not to rub or scrape the sides of the crucible. By stirring, the slag, which commences to rise even during the alloying, is brought almost entirely to the surface. The crucible is then taken out of the furnace, the slag removed from the surface with a skimmer, the metal again stirred to bring up what little slag may still remain in it, and is then ready for casting. It is very injurious to leave it longer in the fire than is absolutely necessary. No flux is required, the bronze needing only to be covered with charcoal powder. The particular point to be attended to in melting the bronze is to handle it as quickly as possible when once melted. When this bronze is made by simply mixing its ingredients, it is brittle, and does not acquire its best qualities until having been cast several times. After three or four meltings it reaches a maximum, at which point it may be melted several times without sensible change. The shrinkage of this bronze in casting is about 50 per cent. more than ordinary brass. The book entitled "Aluminum; its History, Occurrence, Properties, Metallurgy and Applications, including its Alloys," by J. W. Richards, may be of use to you.



(30) A. B., Bangor, Pa., writes: The accompanying sketch represents a wheel with a rope passed over it. I would like to compute the tension at P and Q for holding a weight W, the parts of the rope making any angle with each other. Also, what will be the tension at P when the rope is passed several times around the wheel? *A.*—We understand that when the weight moves, the wheel turns on its axle. In cases of this kind, the wasteful resistances are: Stiffness of the rope, and journal friction; taking these into account, the actual pull P is determined as follows: Let o denote the coefficient of the resistance opposing the motion of the rope as it moves on or leaves the wheel; this resistance is proportional to the tension Q in the advancing part of the rope, and is taken equal to $o\,Q$; its effect is the same as if the force $o\,Q$ resisted the motion of the rope at the points B and D at which the rope is bent. Let Z = pressure on the pin or axle, r = the radius of the axle, R = effective radius of the wheel measured to the center of the rope, u the coefficient of friction, and Q equal the weight of W; then we have:

$$P\,R = Q\,R + 2\,o\,Q\,R + u\,Z\,r. \quad (1)$$

In order to avoid unnecessary refinement in computation, we may take $Z = 2\,Q \sin.\,a$; this value will give us:

$$P\,R = Q\,R + 2\,o\,Q\,R + u\,2\,Q \sin.\,a\,r, \quad (2)$$

and thus the force

$$P = Q\left(1 + 2\,o + 2\,u\,\frac{r}{R}\sin.\,a.\right) \quad (3)$$

In finding the value of o, we must take into the account the diameter of the rope, its quality, its condition (whether new or old). From this it will be seen that it is difficult to determine a correct value for o; some engineers take:

$$2\,o = .457\,\frac{d^2}{R};$$

in which d = diameter of the rope in inches, and R = effective radius of the wheel in inches. The value of $\left(2\,u\,\frac{r}{R}\sin.\,a\right)$ will effect the force P but very little, hence for all practical purposes we may use $P = c\,Q$, in which c is simply a coefficient depending on the diameter of the rope. The values of c for different diameters of ropes are as follows:

Diameter of rope in inches.	⅝	¾	1⅛	1¼	2
c =	1.06	1.10	1.15	1.20	1.24

If, for instance, the diameter of the rope is 2 inches, and the tension Q equal to the weight W is 2,000 pounds, then:

$$P = 2,000 \times 1.24 = 2,480 \text{ pounds.}$$

The number of times the rope is wound around the wheel makes no difference in the value of P in cases of this kind. Of course, the arc of contact $= 2\,a$ will affect it slightly, but this is so small that it has been neglected.

BUSINESS SPECIALS

Transient Advertisements 50 cents a line for each insertion under this head. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue.

Gear Wheels, Gear Cutting. Grant; see page 52.

Forming Lathes, Mer. Mach. Tool Co., Meriden, Ct.

Milling Machs. Kempsmith Co., Milwaukee, Wis.

Patents, H. F. Parker, Att'y, 26 Cort'ndt St., N.Y.

Pattern and Brand Letters. A variety of sizes and styles. Heber Wells, 157 William St., N. Y.

Selden Packing for stuffing box, with or without rubber core. Randolph Brandt, 38 Cortlandt St., N.Y.

Best Presses and Dies for all sheet metal work, Ferracute Machine Company, Bridgeton, N. J.

Air Compressors for every possible duty. Clayton Air Compressor Works, 26 Cortlandt street, N. Y.

Our loose pulley oiler saves you labor, annoyance, money. Kridler Mfg. Co., Grand Rapids, Mich.

Light mach'y built; duplicate parts of tools, etc., mfd.; terms sat'y. L. R. Hitchcock, Watertown, Ct.

Guild & Garrison, Brooklyn, N. Y., manufacture steam pumps, vacuum pumps, vacuum apparatus, air pumps, acid blowers, filter press pumps, etc.

Split Pulleys at low prices, and of same strength and appearance as Whole Pulleys. Yocum & Son's Shafting Works, Drinker St., Philadelphia, Pa.

Improved Duplex and Special Gear Cutters in stock and to order; Gear and Milling Cutters of all descriptions. R. M. Clough, Tolland, Conn.

Squaring and Rotary Shears, Tinsmiths' Tools, Presses and Dies for sheet metal work, are made by the Niagara Stamping and Tool Co., Buffalo, N.Y.

Emery, emery wheels, grinding machines and grinders' supplies, quick process and large stock. When in a hurry, buy of The Tanite Co., New York City, Cincinnati, Ohio, and Stroudsburg, Pa.

New Jersey Art Metal Co., Passaic, N. J., finest thin and ornamental castings in brass, bronze, aluminum, etc.; machinery name plates in brass and aluminum.

Great improvement—Our new Four-spindle Aut. Screw Machines make 3 to 4 four times as many screws as can be made on any other Aut. Mach. E. B. Welch, 68 Devonshire St., Boston.

"Binders" for the AMERICAN MACHINIST. Two styles, the "Common Sense," as heretofore sold by us and mailed to any address at $1.00 each, and the "New Handy," mailed at 50c. each. The former has stiff board covers, while the latter has flexible covers with full page opening flat. Either will hold the entire 52 issues of any volume. AMERICAN MACHINIST PUBLISHING CO., 203 Broadway, New York.

"Indicator Practice and Steam Engine Economy." By F. F. Hemenway. Contains plain directions for using the indicator and making all required calculations from the diagram, also the principles of economy in operating steam engines and current practice in testing engines and boilers. Price, $2 post paid. Published by John Wiley & Sons, 53 East Tenth street, New York.

"Modern Locomotive Construction." By J. G. A. Meyer. In this book the design and construction of all details of the locomotive and tender are considered from a practical standpoint. It contains illustrations of details made from working drawings, accompanied by plain directions for designing, and rules and tables for construction. Adapted to office and shop use. Price, $10. Published by John Wiley & Sons, 53 East Tenth street, New York.

A Milling Cutter Used by Vaucanson.

On this page will be found a reproduction of a photograph of a milling cutter which was made and used by one of the most famous mechanics who ever lived.

The cutter from which the photograph was made is now in the possession of Mr. Lucien Sharpe, of Providence, and was given to him during a recent visit to Paris, by Mr. F. G. Kreutzberger. The last named gentleman, who represents the Brown & Sharpe Mfg. Co., in Paris, is an eminent mechanic and engineer, formerly in charge of the government shops at Puteaux, and thus in close relations with the government official in charge of the Academy of Arts and Measures, where a collection of the works of Vaucanson are to be seen. Recently this collection was rearranged, and the cutters were given away, several of them to Mr. Kreutzberger. The engraving is slightly below the actual size of the cutter.

It is not easy to find on record an account of Vaucanson and his work, but in a book entitled "Universal Biography," published in Paris in 1827, an account of him is given, and a translation of this account we print below, the translation being quite literal but more quaint and more interesting than if put into better English.

TRANSLATION.

Vaucanson (Jacques de), mechanic, born at Grenoble, France, the 24th February, 1709, of a noble family. His taste for mechanics declared itself very early. His mother, a woman of severe piety, permitted him no other dissipation than that of going with her on Sunday to the house of a lady of a devotion equal to her own. During their pious conversations, the young Vaucanson amused himself by examining through a crack in the partition, a clock placed in the neighboring room. He studied its movement, occupied himself in drawing the form and in discovering the play of the pieces, of which he could only see a part. This idea pursued him everywhere. At last he grasped all at once the mechanism of the escapement, which he had been trying to find for several months. From this moment, all his thought was turned to mechanics. He made in wood and with rough instruments, a clock which marked the hours with sufficient exactness. He made for a child's chapel, little angels which moved their wings, automatic priests, who imitated some ecclesiastical functions. Chance fixed his stay in Lyons. There they were talking then of building an hydraulic machine for bringing water to the village. Vaucanson invented one, but was too modest to venture to propose it, but on arriving in Paris, he learned with a joy difficult to describe that the machine of the Samaritan was precisely like that which he had designed at Lyons. Perceiving in every way how much he lacked a knowledge of anatomy, of music, of mechanics, he employed several years in studying the sciences. The flute player of the Tuileries suggested to him the idea of a statue which played tunes and imitated the movements of a player of the flute. The reproaches of an uncle, who treated this project as an extravagance, delayed its execution. It was not until three years later that Vaucanson occupied himself with it, during a long illness. He succeeded to the point that without correction, without hesitation, the machine was put together by the combination of pieces which had been made by different workmen employed separately upon the different parts of the automaton. At the first sounds that the flute player rendered, Vaucanson's servant, who had hidden himself in

the apartment, fell upon his knees before his master, who seemed to him more than a man, and the two embraced each other and wept for joy. To this machine soon succeeded an automaton which played at the same time upon the tambourine and flute. At last appeared two ducks, who paddled, went forth to search for grain, seized it in the trough, and swallowed it. This grain underwent in their stomachs a kind of trituration, and passed into the intestines, following out all the degrees of animal digestion.

In 1740, Vaucanson refused the offers of the King of Prussia, who attempted to assemble in his country all the illustrious men scattered through Europe. A little time afterward, the Cardinal of Fleury attached him to his administration, conferring upon him the inspection of the manufactories of silk. He did not delay to perfect the mill by organization. In a journey which he made to Lyons, he was pursued by the stones of the silk workers, because they had heard it said that he was trying to simplify their looms. To avenge himself, he built a machine with which an idiot could make a cloth with flowers in it. He made an end by this to a discussion wherein they were making of value next to the government the little common intelligence which should be had by a workman in silk cloth, with a view of obtaining in favor of these fabrics some privileges which ignorance affords often to cunning under a pretext so common and often so deceiving to the good public. Vaucanson made also for the representation of the Cleopatra of Marmontel an asp which darted forth, hissing, upon the breast of the actress, which made the people say jokingly, when they were discussing the merit of the tragedy: I am of the opinion of the asp. Vaucanson was occupied in secret by an idea, in the execution of which Louis XV. interested himself. This was the construction of an automaton, in the interior of which should be operated all the mechanism of the circulation of the blood, but he was disgusted by the delays which the execution of the orders of the king met. Voltaire made then upon him the following verse:

The intrepid Vaucanson, rival of Prometheus,
See ned. imitating nature by springs,
To take the play of the heavens to animate the body.

Attacked for several years by a long and cruel illness, he preserved to the last moment all his activity. He was occupied still to the end of his life in completing a machine which he had invented for making his endless chain. "Lose no time," he said to the workmen, "I perhaps shall not live long enough to explain all my idea."

He finally terminated his career the 21st of November, 1782. He kept his bed during the last eighteen months of his life from a complication of the most serious maladies, and his parents desired then that he should give some signs of return to religion. It was only with much pains that they were able to persuade him to confess. One reads this epitaph upon his tomb in the Church of St. Marguerite:

"Bonus omnibus pietate, caritate, verecundia flebilis."

This was, in effect, a good father of the family, and truly a good man. A collection of machines, forming the Conservatory of Arts and Measures which he had established at Paris, rue de Charonne, was placed after his death under the direction of Vandermonde. His elegy as a member of the Academy of Science was composed by Condorcet.

A New Bench Shear.

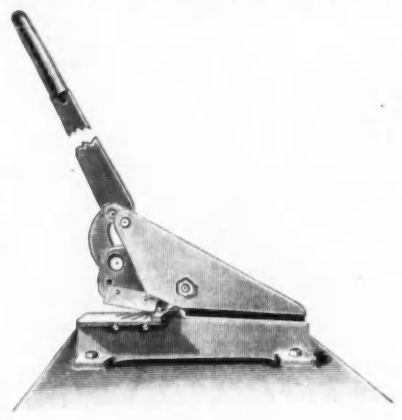
We illustrate herewith a small bench shear which can be arranged to be worked by hand as shown, or by foot power, or by a combination of the two, and it is changed from hand to foot power or *vice versa* by simply drawing a pin. The hand shear will cut $\frac{3}{16}$-inch stock, the foot shear $\frac{1}{4}$-inch stock, they are made with 4-inch and 6-inch blades. The frame is recessed out so that wide sheets can be readily cut into, the edge passing through the recess. There are two gauges, one for slitting up to 6 inches wide, one for squaring and angular work. The table is graduated into 90 degrees, 75 degrees, 60 degrees, 45 degrees and 30 degrees.

R. M. Clough, Tolland, Conn., is the manufacturer.

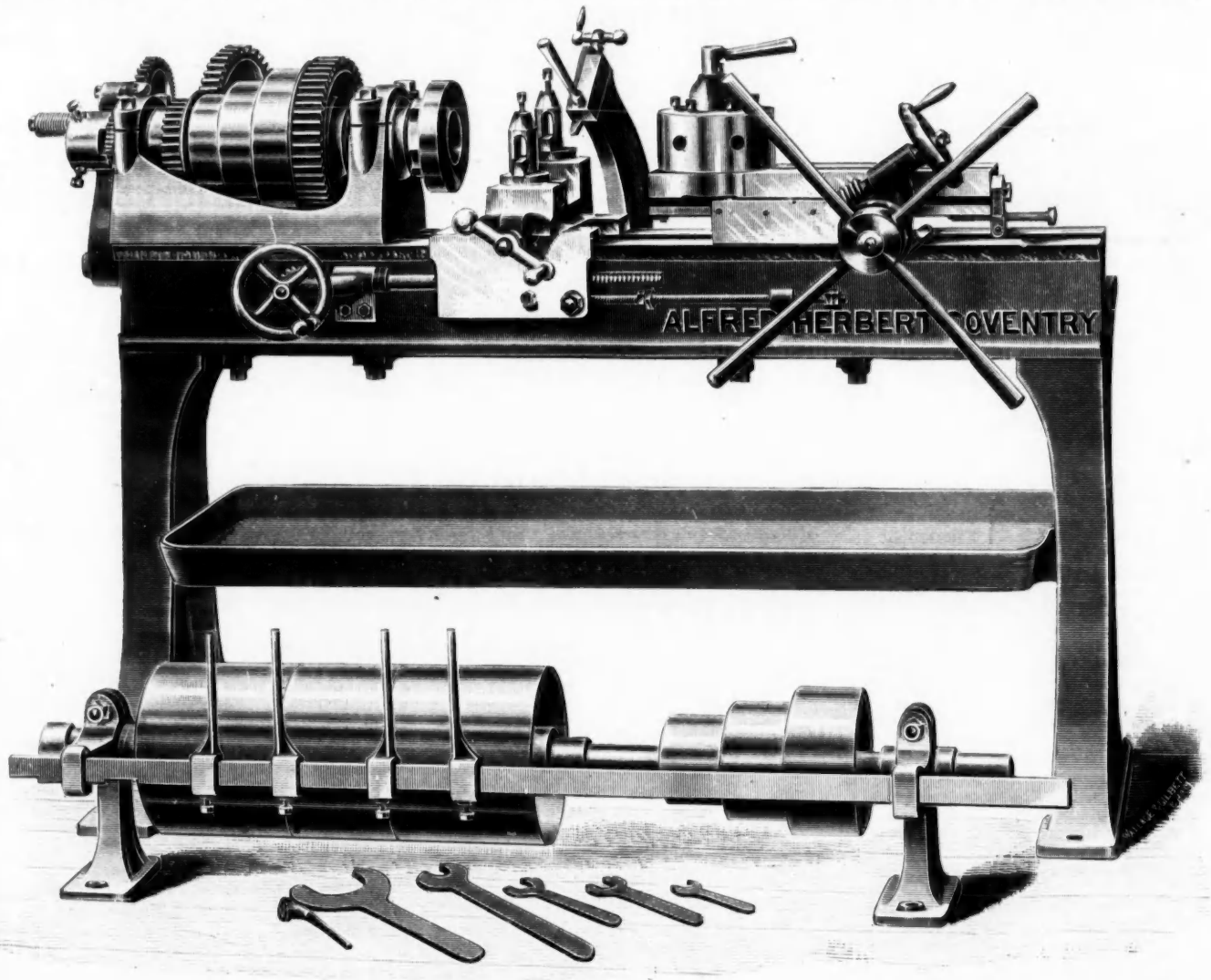
Turret Screw Machine with Chasing Bar.

In our issue of December 27th we published an illustration of a turret head screw machine made by Alfred Herbert, of Coventry, England.

The tool which we now illustrate is somewhat similar, except that the rod feed is not used, but in its place a chuck; there are back gears and a chasing bar, as shown. It is intended for heavier and somewhat different work from that for which the previously shown machine was designed, and may have fitted to the spindle any form of regular or special chuck for holding castings or forgings, and it will also make screws or studs from the end of a bar. The machine swings work 12 inches diameter.



BENCH SHEAR.



SCREW MACHINE WITH CHASING BAR.

Joule—The Conservation of Energy.

"It is unnecessary to repeat the oft-told tale of how the pioneers of the great generalization, now called the Conservation of Energy, were for a time ignored. German physicists turned away from Mayer. England would not hear, or listened in unintelligent silence, to Joule. But the year 1847 was an epoch in the history of science. Joule himself, for the first time, claimed the full extent of the territory he had conquered. "On the 28th of April, 1847," says his biographer, "Joule gave a popular lecture in Manchester, at St. Anne's Church Reading Room," and chose this opportunity to deliver "the first full and clear exposition of the universal conservation of that principle now called energy."

The local press would at first have nothing to do with the address. "One paper refused to give even a notice of it." "The Manchester *Guardian* would, as a favor, print extracts to be selected by themselves." Finally the Manchester *Courier*, after long debate, promised to insert the whole as a special favor, not to Joule, but to his brother.

Of course no blame can attach to the newspaper men for failing to recognize the importance of views that were rejected by many of the best-known scientific authorities, but the theories which in April were hawked from one provincial editor to another, found in June, when the British Association met at Oxford, an advocate who compelled attention. Joule has told the story himself. All the circumstances were depressing. An earlier paper read some years before, had attracted little notice. The chairman, perhaps on this account, suggested that the author should be brief. No discussion was invited. In a moment the meeting would have passed to other business, and the enunciation of his views would once more have failed "if a young man had not risen in the section and, by his intelligent observations, created a lively interest in the new theory. The young man was William Thomson." The result was that the paper created a great sensation, and from that moment the tide of opinion turned.—*The Fortnightly Review.*

Locomotives Built Last Year.

Locomotive building is shown to have fallen off tremendously in the past year, according to our reports of the output of the various contracting works. The decrease in the number built is fully two-thirds, as compared with the previous year. Reports from thirteen companies make the total 695 locomotives for 1894, against 2,011 locomotives built in 1893. Three companies, building nearly 90 locomotives in 1893, did not turn out a single new locomotive in 1894. Of course, when the general totals show such a great decrease, it is not to be expected that any one manufacturer would be fortunate enough to build anything like his previous year's work. As a matter of fact, no one company built half as many locomotives in 1894 as in 1893, and only the smaller builders were able to keep within a third of the output recorded for 1894.

These figures are unprecedented in locomotive building in the United States. Going back five years, we get the following record of locomotives built in the United States: In 1894, ten companies built 695 locomotives (three built none); in 1893, fourteen built 2,011; in 1892, thirteen built 2,012; in 1891, thirteen built 2,165; in 1890, fifteen built 2,300.

It is to be noted that over 80 locomotives of the total number built in 1894 were built for export.

The Cult of Keely.

A writer in the New York *Times* says: A recently-established quarterly whose *raison d'être* seems to be the re-establishment of the cult of Keely (he of the motor), which has sadly fallen off recently, publishes a review of what it terms "A Remarkable Book," being nothing else than an account of the said Keely's life and "inventions," by one of his ardent disciples. From this we obtain the interesting information that the Philadelphia sage made a great mistake by devoting himself to invention instead of to discovery. He has now abandoned the former pursuit and betaken himself to the latter. This is, in one sense at least, a happy move. People demand something tangible from an inventor; when he announces that he has devised a machine that will move a mountain with a teaspoonful of water, they naturally ask to see it work, and if it fails to work they are apt to call him a fraud. But with a discoverer it is quite different. All he has to do is to announce that he has found a new form of force, and he will be quoted by the papers and attain a certain standing with the public. Of course, scientific men will demand something better than this;

but they form an inconsiderable part of mankind and may safely be neglected. The only trouble with all this is that there seems to be no money in it. An inventor can issue stock; a discoverer can scarcely do that. Perhaps Mr. Keely is preparing for a lecture tour, in which case a long-suffering public is to be heartily commiserated.

Wages on a Railroad.

A recently issued report of the New York Central Railroad gives some information about wages. Sixty-nine general officers receive an average of $6,030 a year. The class that draws the next highest average pay are the locomotive engineers, who average $1,220 each. Conductors have averaged during the past year $931. The general office clerks have $808 each, and then come the employes on the floating equipment, who have $704 each. Mechanics and helpers on the road receive about $664, and firemen and wipers $646. Station agents get $633, and trainmen, other than engineers, firemen and conductors, have the same wages. Roadmasters and track foremen average $609, and telegraph operators have $600.

Station men, other than agents and telegraphers, average $565, and mechanics and helpers in the shops are paid $523. Switchmen, flagmen and watchmen receive $500; shopmen, other than mechanics and helpers, make about $460, and trackmen have $419. The most numerous class on the road are the station men, other than agents and telegraph operators, of whom there are 5,314. Next come the 4,379 trackmen, 3,516 mechanics and helpers in the shops, and the 2,523 switchmen.

A Machine Shop Fire.

Under date of January 7th Bardons & Oliver, Cleveland, Ohio, write us: We regret to announce that our shop was entirely destroyed by fire on the night of January 3d. All of our patterns were lost, but the larger part of the tracings, which were contained in safe, were comparatively uninjured. We secured temporary quarters the next day at 122 Water street, and have two draftsmen and two patternmakers at work again. Orders for the larger part of our machinery have already been placed, and the balance will be ordered within the next ten days. We expect to secure permanent quarters during the coming week, and hope to commence shipping again before February 1st. While our insurance will nearly cover the loss on machinery and tools, it cannot protect us from our loss of note-books, catalogs, memoranda, etc., the accumulation of nearly 15 years. We shall esteem it a special favor if our friends will forward us, as soon as possible, copies of their circulars and catalogs, and such photographs as they can spare.

Comparison Between Lathe and Grinder.

An English tool builder states in "the deadly parallel" the advantages of grinding over finishing lathe work in the lathe as follows:

LATHE.

The live center of the lathe is invariably more or less out of truth, which leads to trouble when a piece of work is turned end for end. This source of inaccuracy is familiar to every turner, and renders the production of a true spindle a practical impossibility.

Any inaccuracy in the lathe spindle is reproduced in the work.

A lathe tool will not cut unless there be a certain amount of pressure, and, on small work, this produces springing and consequent irregularity.

In all lathe work any lack of uniformity in the density of the work causes a corresponding variation in the accuracy of the result.

Filing work whilst revolving, which is the usual method of attempting to obliterate the irregularities of lathe work, produces a surface which is neither true nor round, and the subsequent use of emery in some form rapidly wears out the exposed slides of the lathe, and still further reduces its chances of doing accurate work.

On hardened work the lathe is useless, and in many cases where hardened spindles or bushes are desirable, the lack of means to produce them leads to the substitution of soft work.

Where each lathe is required to finish its own work, it is imperative to employ highly skilled labor, and the responsibility for any imperfect work is difficult to bring home to the man really in fault.

GRINDER.

In the grinder the work revolves on dead centers, so that the work may be turned end for end without disturbing its truth.

The spindle of the driving head in the grinder remains fixed, so that should any such inaccuracy exist it could not affect the work.

An emery wheel requires only an infinitely small amount of pressure.

The cutting power of an emery wheel is not affected to any appreciable extent by such variations of hardness or density.

The surface produced by the grinder is uniform and true, and is susceptible of a high polish. The machine is specially constructed for preventing the access of emery dust to the slides, which consequently remain in good condition for years.

The grinder operates with the same ease on hard as on soft work, so that hardened spindles, etc., may be employed where desirable at a cost but slightly in excess of soft.

The grinder finishes the work of many lathes, and takes the responsibility as regards size and finish. The lathes simply rough out the work for the grinder, and a less skilled, and consequently less expensive grade of labor can be employed on the lathes.

Why Does a Bicycle (or a Broomstick) Stand Up?

BY H. M. NORRIS.

The subject now under discussion in the columns of the AMERICAN MACHINIST, "Why Does a Bicycle Stand Up?" is one in which I am greatly interested.

In a paper read before a meeting of mechanical engineers, and afterwards reported at great length in *Nature*, Mr. C. Vernon Boys claims that the stability of the bicycle is due to the same principle as that of a top in action. Another writer likens the principle of a bicycle to that of a gyroscope. Some say it is like that form of gyroscope which Sir William Thompson calls a gyrostat. Others, like Mr. Begtrup, attribute it to the principle embodied in Newton's first law, "A body in motion, if left to itself, will continue to move in a straight line forever;" while Mr. Oberlin Smith endeavors to point out the connecting link between a man on a wheel and one astride a door eating apples.

If a broomstick will stand up when leaned against a house; if it will stand up when stuck in a mud bank; if it will stand up when balanced upon the end of one's finger, or his nose; why then is all this mystery about the standing up qualities of a bicycle?

A bicycle will stand up when leaned against a house. It will stand up when stuck in a mud bank. And it will also stand up when balanced like a broomstick.

Mr. Begtrup says, "The stability of a rolling wheel does not depend on human skill or instinct—it will stay upright whether there is a human being on top of it or not; the upright position is the natural position for a rolling wheel." From this statement, it is very evident that Mr. Begtrup has never tried to ride a unicycle, or he would have long since had it knocked into him, and by no means gently, that the down-right-quick position is the natural one for a wheel with a man on it.

A unicycle is, of course, far more difficult to ride than a bicycle, but the principle of the one is the principle of the other, and both principles analogous to the principle of balancing one's self on a pair of stilts. On a unicycle the rider pedals forward when falling forward; backward, when falling backward. And when he starts falling to the right, *he turns his wheel to the right;* when to the left, he turns his wheel to the left. The writer has ridden many miles on one wheel, and knows whereof he speaks.

In the case of the bicycle, the rider need only guard against falling to the right or left, and hence the case of "standing still," when the front wheel is turned at an angle to the rear one. When the machine starts to fall to the right, the rider pedals to the right; when to the left, he pedals to the left. Likewise, a boy on a pair of stilts steps forward, when falling forward, and backward, when falling backward. The principle in each and every case being identical—the point of support always being kept under the center of gravity.

If *A* and *B*, Fig. 1, represent the two points of support of a bicycle in equilibrium, then the center of gravity must fall on the base line *A B*. But if we consider that the bicycle is in the act of falling, and that it has tilted over until the center of gravity has reached a point *C*, then the front wheel must be turned to the right until its point of support is again in line with the points *B* and *C*.

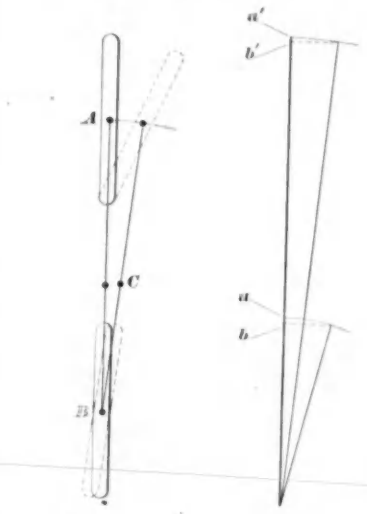


Fig. 1 *Fig. 2*

American Machinist

Since the velocity of a body moving under the influence of gravitation varies as the square root of the hight from which it has fallen, a wheel 60 inches high will only be tilting over at the rate of about 5,000 feet per hour when 6 inches out of the perpendicular. To keep the points of support under the center of gravity, the bottom of the front wheel need only move to the right or left a trifle faster than this slow rate. If the bicycle begins falling to the right when going at the rate of eight miles an hour, it is only necessary to turn the handles about seven degrees to the right; when going four miles an hour, about fourteen degrees; and two miles an hour, about twenty-eight degrees. Hence, the greater the speed, the less the angle; and the slower the speed, the more the handles must be turned.

Mr. Beach says, "It is much easier to keep one's balance with the feet on the pedals, than when coasting." I do not think this is so, for the higher the legs are held, the higher the center of gravity is raised, and the greater the stability of the machine. Just as a broomstick is easier to balance on the finger than a match, so is a wheel with a weight in the saddle easier to balance than a wheel with a weight under the saddle, and the higher and heavier the weight, the less the danger of falling. When passing a point 6 inches out of the perpendicular, a weight on the end of a 2-foot rod, Fig. 2, will be tilting over at a rate represented by the line *a b*, while a weight on the end of a 5-foot rod will pass the 6-inch point only at a rate represented by *a' b'*.

Referring again to Mr. Begtrup's article, we find he says, "When a bicycle rider runs down hill he has nothing to do but to keep his wheel steady." This is entirely true when going at a high rate of speed; it being only necessary to turn the handles when riding at a moderate or slow speed. Riding at a high rate, say, a mile in less than three minutes, a bicycle will keep straight on even if both hands and feet are removed. And as the speed slackens, equilibrium can still be maintained by inclining the body to the right or left. This does not seem strictly in accordance with what has gone before, but the conditions are different. Generally speaking, and as the world understands it, a bicycle is balanced by means of turning the handles to the right or left; but when a high rate of speed is attained, inertia plays a most important part in its stability, the inertia opposing the curvilinear motion, and hence holding the wheel in dynamical equilibrium. The truth of this statement is further demonstrated by the trick of dropping out of the saddle while the wheel is in motion, and picking up an object from the ground while the wheel runs ahead until the rider catches it and vaults into the saddle; this can be done without materially altering the course of the wheel.

Overlooking the inconsistency of comparing a single wheel resting upon one point with two wheels fastened together and resting upon two points, the writer would sum the matter up by saying that Mr. Begtrup's theory is correct for certain conditions, and that Mr. Smith's theory is correct for certain other conditions; the conditions being based upon the rate of speed at which a bicycle is going.

MANUFACTURERS

The Berlin Iron Bridge Co., of East Berlin, Conn., are putting up a large iron bridge at Collinsville, Conn.

A. T. Wing & Sons, Old Town, Maine, will commence work upon the foundation for their new mill early next spring.

The Livingston Manufacturing Company will erect a plant at Rockland, Maine. The main building is to be 70x72 feet in size.

The Naugatuck Manufacturing Company has been organized at Naugatuck, Conn., to develop any and all process s for the working of metals. The capital stock of the company is $10,000.

The new car barn for The Lehigh Traction Co., at Hazelton, Pa., is to be built by The Berlin Iron Bridge Co., of East Berlin, Conn. The same company have a contract for the new power house for The Keene Gas Co., at Keene, N. H.

We have received from the Foster Engineering Co., Newark, N. J., a pamphlet entitled "Facts Worth Knowing About Pressure Regulators, Reducing Valves and Pump Governors." The title is accurately descriptive of the pamphlet, and it will be found interesting and valuable to those connected with steam plants. It is sent to those interested on application.

We have received from A. Wells Case, Highland Park, Conn., a finely gotten up catalog illustrating and describing the Case improved propeller wheels, which seem to be made particularly for small classes of vessels, such as yachts, launches, etc., it being claimed for these wheels that they will give greatly increased speed over other forms. The catalog is sent to those interested on application.

A new company has been organized in St. Albans, Vt., for the purpose of manufacturing boxes and box machines, with a capital of $10,000. Calvin B. Southard is president; Warren J. Foss, treasurer; L. D. Mathews, secretary; Calvin B. Southard, Warren J. Foss and L. D. Mathews, directors. The intention of the company is to make box shooks of any dimensions that may be wanted, and do a general woodworking business.

It is stated that the factories of Wallace & Sons, in Ansonia, Conn., will not shut down indefinitely as has been stated. The factory formerly employed 1,000 hands, and has been employing 500 for a few months since the failure and change of management. If the Wallaces gain control, the business will go on, otherwise the plans cannot be definitely stated. It is said, however, that the factory will in no case shut down indefinitely.

We have received from the Meriden Machine Tool Co., Meriden, Conn., their new 1895 catalog (standard size 6 by 9 inches). It contains illustrations and descriptions of their specialties in the way of forming lathes, turret lathes, floss silk winders, etc., and will be found interesting and useful to those who are connected with the production of quantities of duplicate work, such as these machines are adapted for. It is sent to those interested upon application.

The Lodge & Davis Machine Tool Co., of Cincinnati, Ohio, have just received an order from The Vulcan Maschinenfabriks-Actien Gesellschaft, of

Wien, Austria, for several of their engine lathes to be driven by direct connected motors. This concern is one of the leading manufacturers of Wien and are in the center of an extensive electrical manufacturing district. They propose to do away with overhanging shafts, pulleys, etc., and arrange all their tools to be driven exclusively by motors. The Lodge & Davis Machine Tool Co. state that they are receiving quite a number of inquiries from Germany for motor-driven tools, and that there seems to be an unusual amount of interest manifested in this new system.

The Tradesman, Chattanooga, Tenn., in its report on the industrial condition of the South for the week ending January 7th, reports that the condition of business, as shown by the January settlements, is quite satisfactory. Collections are good, and terms of credit have been well maintained. Coal miners report increased demand for their output, and firmer prices. The Southern iron manufacturers are still increasing the volume of their business, with favorable prospects. New textile mills, some on a large scale, are reported. Among the important new industries organized or incorporated during the week are: A 25,000 spindle cotton-mill at Alabama City, Ala., by the Dwight Manufacturing Co., of Chicopee, Mass.; a $150,000 cotton-mill at Dallas, Texas; a $250,000 naval stores company at Savannah, Ga., and lumber companies, each with $100,000 capital at Valdosta, Ga., and Lodi, Texas. An asphalt mining company with $50,000 capital is reported at Saint Jo, Texas; a $20,000 factory at Moss Point, Miss.; brick works to cost $20,000 at San Antonio, Texas, and a $10,000 furniture factory at Houston, Texas. There are also reported an electrical plant at Beaufort, S. C.; fertilizer works at Dry Bridge, Va.; flour and grist-mills at Hall's Mills, N. C.; Field, S. C.; Pinewood, Tenn., and Cranks, Va., and ice factories at Raleigh, N. C., and Wheeling, Va. A foundry and machine shop will be built at South Boston, Va.; a moss factory at Lake City, Fla.; phosphate works at Ocola, Fla., and woodworking plants at Alberton, Ala.; Jonesboro, Ark.; Pachuta, Miss.; Huntington, Tenn., and Rockdale, Texas. The enlargements for the week include machine works at Chattanooga and Harriman, Tenn., an electrical plant at Fort Worth, Texas, and cotton-mills at Laurel Hill, N. C.

Machinists' Supplies and Iron.

New York, January 12, 1895.

Iron—American Pig—We quote standard brands, $12 to $12.50 for No. 1; $11 to $12 for No. 2, and $10.50 to $11 for No. 2 Plain. Southern brands, $11.25 to $11.50 for No. 1; $10.25 to $11 for No. 2; $10 to $10.50 for No. 3; $10.50 to $10.75 for No. 1 soft; $10.25 to $10.75 for No. 2 soft; and Foundry No. 4, $9.50 to $10.

Antimony—The market is firm with higher prices. We quote L. X., 8¼c. to 8¾c.; Cookson's, 9c. to 9½c.; Hallett's, 7.30c. to 7.35c.; and U. S. French Star, 8c.

Lard Oil—Prime City we quote at 55c. to 56c.

Copper—The market is steady with an increase of business. Lake Copper is quoted at 10c. Casting Copper is held at 9½c.

Lead—The market is active and shows a decided improvement. We quote 3.10c. to 3.12½c. for New York delivery; buyers bid up to this price.

Spelter—The market is dull. Spot spelter is quoted at 3.30c.

Tin—The market is easy. Business has been transacted at 13.35c. to 13.45c. for January.

✻WANTED✻

"Situation and Help" Advertisements only inserted under this head. Rate 90 cents a line for each insertion. About seven words make a line. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Young machinist wants pos. H. E. Beck, Bellefonte, Pa.

Draftsman, four years' experience, is open for engagement. L., 817 N. Eighth St., Philadelphia, Pa.

Wanted—A situation as foundry foreman. Address Founder, care J. W. See, Hamilton, Ohio.

Patternmaker wants position; best of references given. Address J. H., care American Machinist.

Pos. Wanted—By a first class machinist, draftsman & a thor. mechanic. Box 93, Am. Machinist.

Mech. draftsman wants position; good refs. N. Y. preferred. Box 94, American Machinist.

Wanted—Sit. by chief draftsman & designer; 15 years exp. in shop & drawing room, versed in mod. methods & shop practice. Box 91, Am. Machinist.

Wanted—To increase our force with 3 or 4 good machinists, and 2 molders, to work on steam engines; shop located in Western Penna. Address "Increase," care of American Machinist.

Wanted—Exp'd mechanical draftsman for detail shop drawings; state exp., & wages expected; permanent work for active, competent man. The Western Gas Construction Co., Fort Wayne, Ind.

Wanted—A No. 1 foundry foreman, who understands his business and can manage and hold his men, and get work out cheaply. Modern methods. In answering, state full particulars. Address Andrews, care American Machinist.

Wanted at Cleveland, Ohio—Foreman for small machine shop working on repair work; applicant must have prac. experience with fair education. Address in his own hand writing, stating age, exp., education & wages expected, Box 92, Amer. Mach.

Wanted—Five first-class tool makers, accustomed to light work such as sewing machines, watches, bicycle tools, etc.; none but experienced first class workmen with good references need apply; steady employment and good wages. The National Cash Register Co., Dayton, Ohio.

Wanted, immediately—First-class foreman for blacksmith shop running 15 fires; must be expert in all kinds of blacksmith work & hard'g tools, dies, etc.; none but first-class man need apply. Address, stating exp. as foreman & wages expected, John Kruesi, General Manager General Electric Co., Schenectady, N. Y.

The head designer and draftsman in a large machine shop desires evening employment in N. Y. City of any kind or description; steam, electric, hydraulic, tools or general machine work; parties rushed with work or wishing assistance in working out mechanical problems for the shop, patent office or courts can have competent assistance by addressing Experience, American Machinist office.

✢ MISCELLANEOUS WANTS ✢

Advertisements will be inserted under this head at 35 cents per line, each insertion. Copy should be sent to reach us not later than Saturday morning for the ensuing week's issue. Answers addressed to our care will be forwarded.

Cheap 2d hd lathes & planers. S.M.York, Clev'd, O.

Auto. Steam Flue Cleaners. Kelley Co., Erie, Pa.

Calipers & Gauges. F. A. Welles, Milwaukee, Wis.

Thermometers given mechanics. C. Hess, Clev'd, O.

For Sale—Second-hand drill presses, engine lathes & planers. Dietz, Schumacher & Co., Cincinnati, O.

Light and fine mach'y to order; models and electrical work specialty. E. O. Chase, Newark, N. J.

Wanted—A purchaser for a good key-seater, by Mitts & Merrill, 913 Tilden Street, Saginaw, Mich.

Wanted—To buy good second-hand tools. Box 83, American Machinist.

"Draftsmen's combination triangles clean, transparent, tough." D. J. Kelsey, New Haven, Conn.

Model Locomotive Castings. Latest design. G. H. Olney, 163 Herkimer street, Brooklyn, N. Y.

For Sale—A first class key seater, new. Address Mitts & Merrill, 913 Tilden St., Saginaw, Mich.

Cheap—Nearly new, Schaeffer & Budenberg tachometer. Address Box 90, care of Am. Machinist.

Wanted—2 hand modern 18" or 20" lathe, 10 foot bed. Box 360, Dolgeville, N. Y.

Wanted—A set of engine patterns from 5 H. P. to 50 H. P.; give full description and price. The Middletown Machine Co., Middletown, Ohio.

Wanted—To correspond with any one in need of a first-class key-seater. Address Mitts & Merrill, No. 913 Tilden Street, Saginaw, Mich.

Every mechanic should have a copy of "Pocket Primer of the Air Brake." Sent to any address for 50 cents. W. S. Rogers, Buffalo, N. Y.

Wanted—The address of a firm for steam laundry supplies. Send particulars to H. H., care of J. Piotrowski, a co-advertising agency, Warsaw (Poland), Senatorska 26.

Designing and drafting done at home by two mechanical engineers of large experience in mechanical and electrical work; new ideas worked out. Address M. S., American Machinist.

Wanted—To hear from responsible parties who want marketable tools or machines built in first-class shop and sold on royalty. F. F. Hemenway, care American Machinist.

REDUCING VALVES

For reducing and maintaining an even steam, air or water pressure. These valves have been on the market for years, and are used by all the best and largest steam plants of the world.

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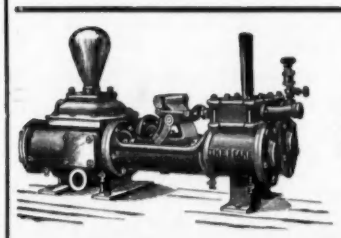

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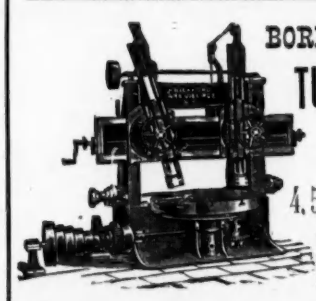

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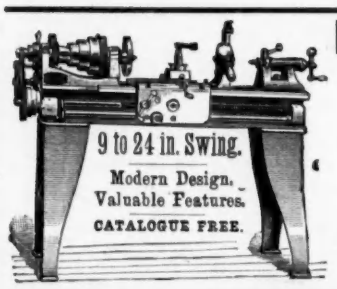

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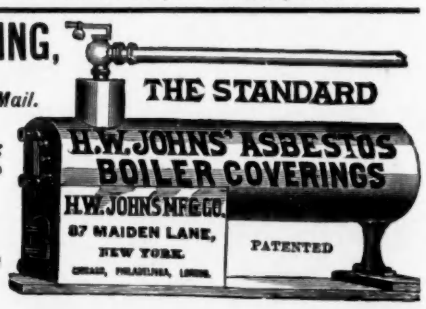

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FRANK L. WILCOX, Treasurer. GEO. H. SAGE, Secretary.

Engineers, Architects and Builders of

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The above illustration, taken direct from a photograph, shows the interior of an Iron Foundry designed and built by us for The Farrel Foundry and Machine Co., at Ansonia, Conn. The building is 129 feet in width by 302 feet in length. The wings are 80 feet and 43 feet respectively, and the central portion is 56 feet in width. The central portion of the building is controlled by a hydraulic traveling crane, with a travel the full length of the building, and is also arranged with jib cranes for delivering material from the traveling crane to the cranes in the wing trusses.

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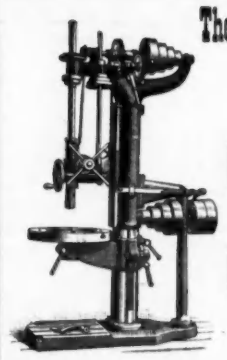

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3	1	.70	12	3	1.60
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5	1¼	.80	14	4	2.10
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8	1¾	1.10	17	5½	4.00
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1 Set to 2 in.		7.80	Full Set.		$31.10

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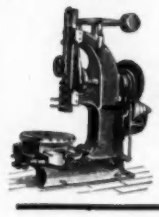

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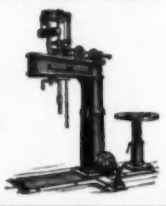
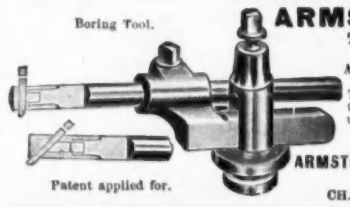


Boring Tool.



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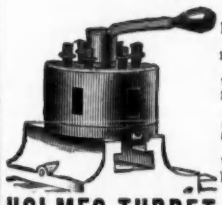

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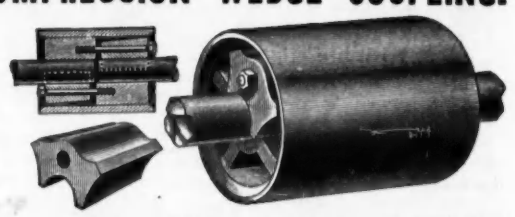

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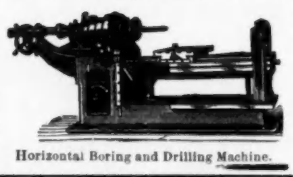
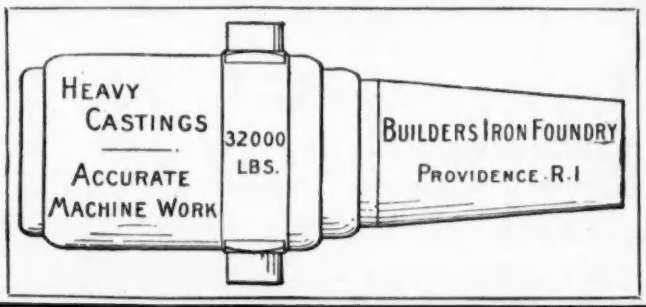


Horizontal Boring and Drilling Machine.



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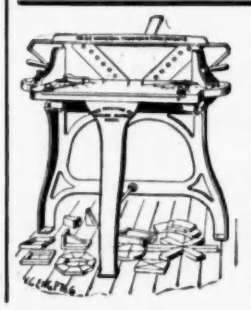

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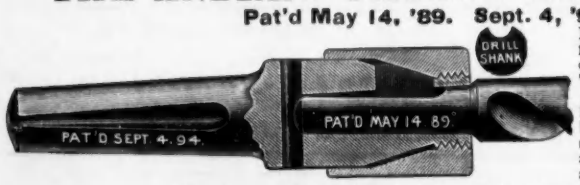

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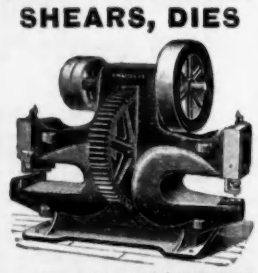

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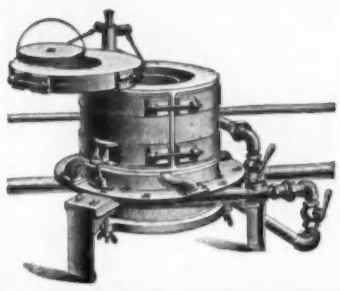

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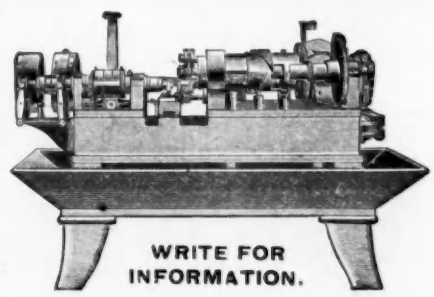

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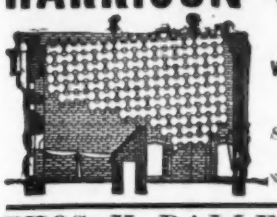

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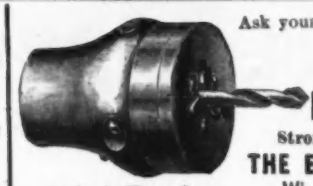

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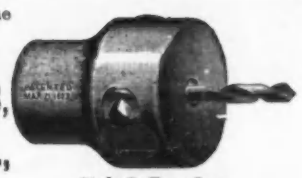

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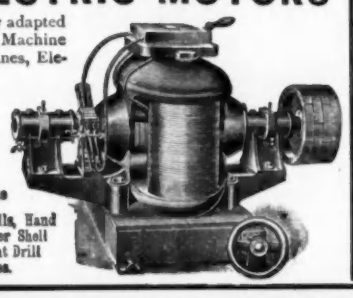

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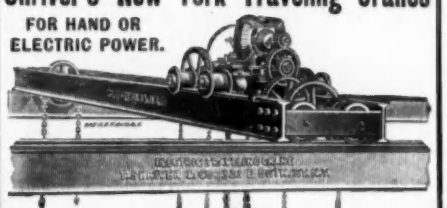

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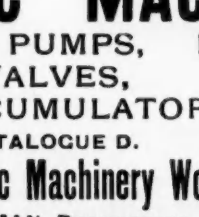

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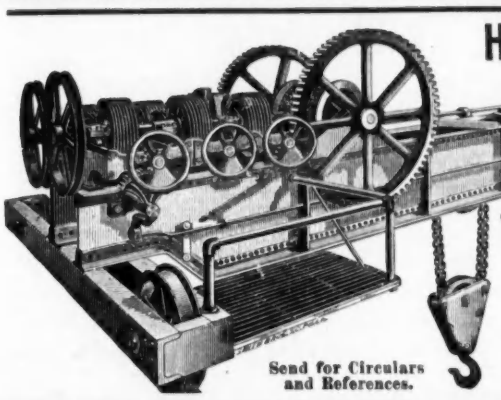

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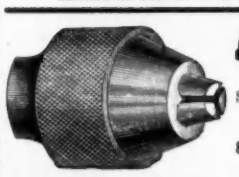

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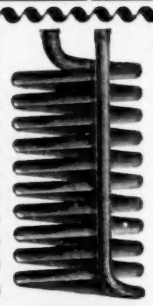

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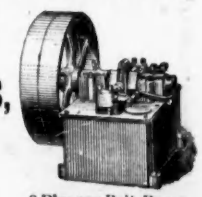

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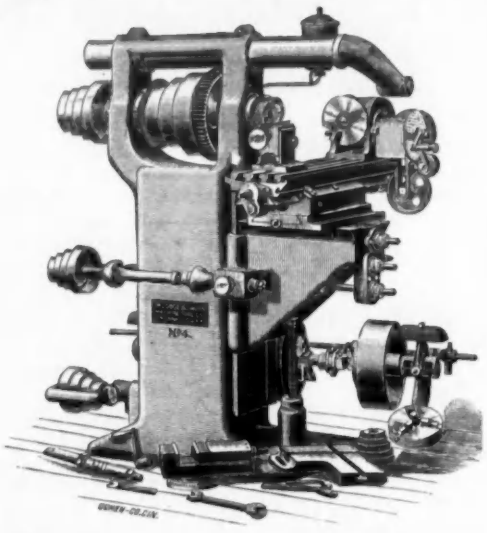

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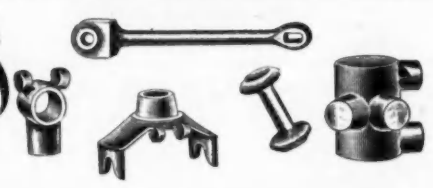

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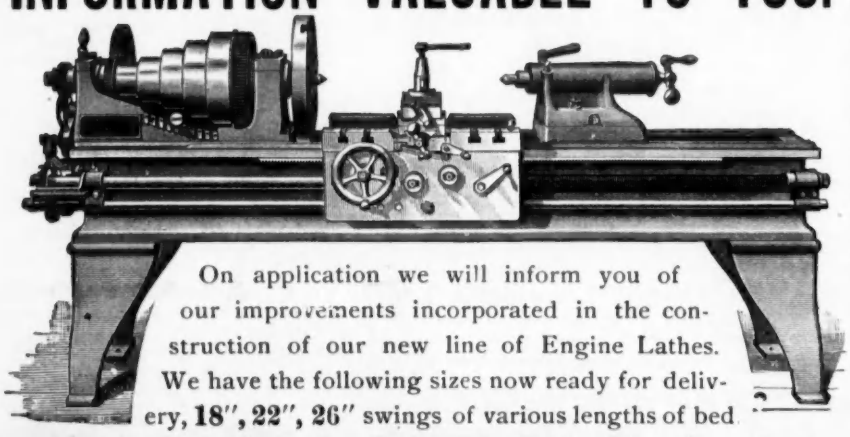

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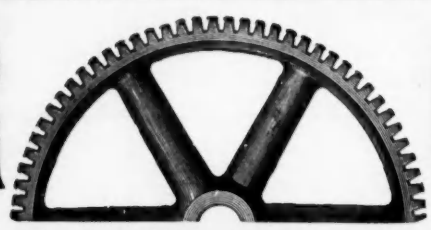

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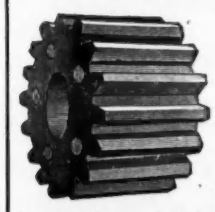

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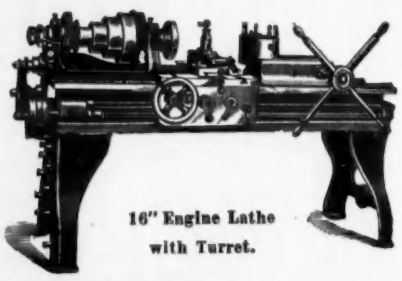

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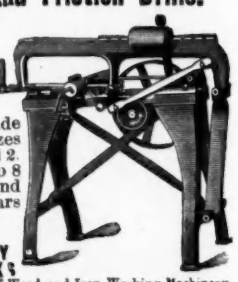

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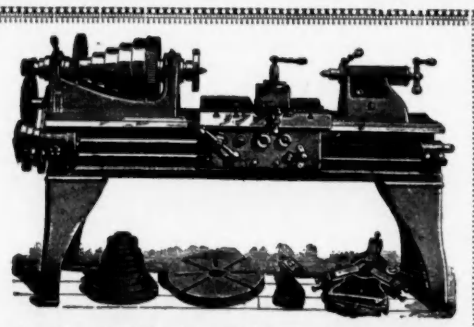

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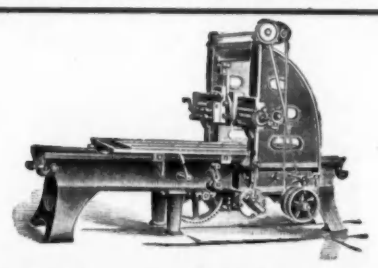

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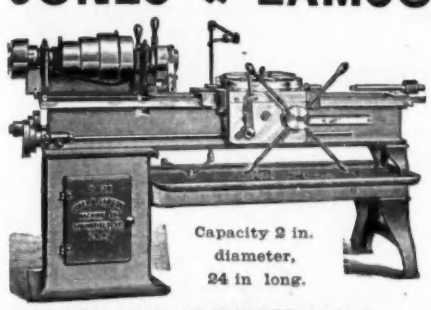

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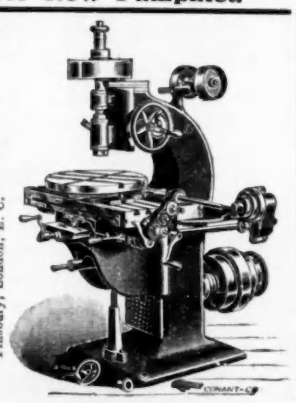

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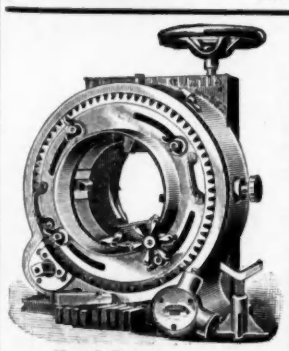

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And Byron sang of love and war,
And Wordsworth sang the joys of home.
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The theme I seek to celebrate
Is new and fresh, and I may say,
Conspicuously up to date—
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I know that Rome and ancient Troy
And love and war, and things like these,
Are generally held to be—
Excuse the phrase—the poet's cheese.
But why should I, O prithee tell,
Not soar on wings of poesy
And sing the glories of a pump?—
That is, provided it should be—
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For the Mason Boiler Feed Pump
Has more good points than a porcupine;
Material, finish, workmanship,
You'll find them all surpassing fine.
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A truth I think none will combat—
For run it fast or run it slow,
This pump is so constructed that
It
Can't
Hang
Up.

For when the first valve—there are two—
The main and the auxiliary—
Comes to the centre, there's no stop;
The other opens wide, you see.
So be the pressure high or low,
The load however large or small,
To the Mason Boiler Feed Pump
It makes no difference at all:—
It
Can't
Hang
Up.

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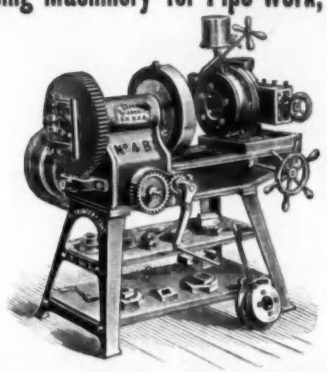
As soon's the main valve is reversed,
The other laps and holds the steam;
It's noiseless as a summer breeze;
And there's no jar; not e'en a trill;
It could not break if it should try;
And what is more important still,—
It
Can't
Hang
Up.

And all the parts are made to gauge
As much alike as two twin hairs;
And strictly interchangeable;
Which much facilitates repairs;
And the water end's valve area
Is plenty big enough to let
You make repairs with utmost ease;
And—even more important yet—
It
Can't
Hang
Up.

Oh, I could sing from now till Jt
One glad triumphant ceaseless song:
Oh, I could celebrate, I'm sure,
Month after month the whole day long,
The Mason Boiler Feed Pump,
And all its merits manifold;
Though this the chiefest merit there,
I'm after all inclined to hold;—
It
Can't
Hang
Up.

Now, if you feel, plain man of prose,
Inclined to doubt what poets say,
Or think when poets get on pumps,
They're liable to go astray,
Why, there's a mighty easy way
To dissipate corroding doubt;
Just come and see the thing yourself,
You'll find I've told the truth about
The Up.
Mason Hang
Boiler Can't
Feed Which
Pump,—

D. SAUNDERS' SONS,
MANUFACTURERS OF
PIPE CUTTING AND THREADING MACHINES,
Steam and Gasfitters' Hand Tools,
Tapping Machinery for Pipe Work, etc.



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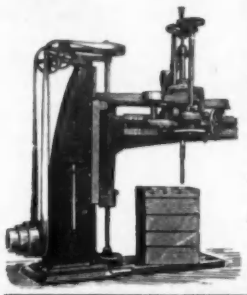

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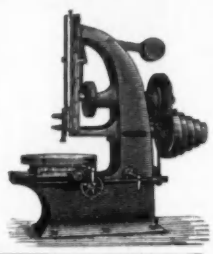

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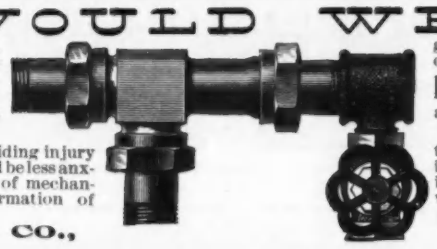

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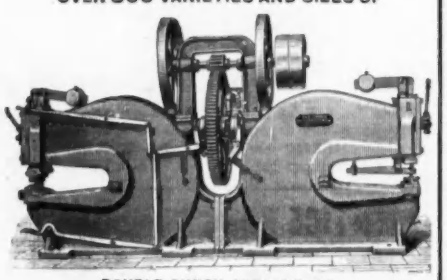

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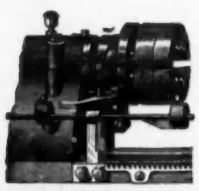

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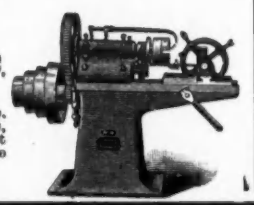

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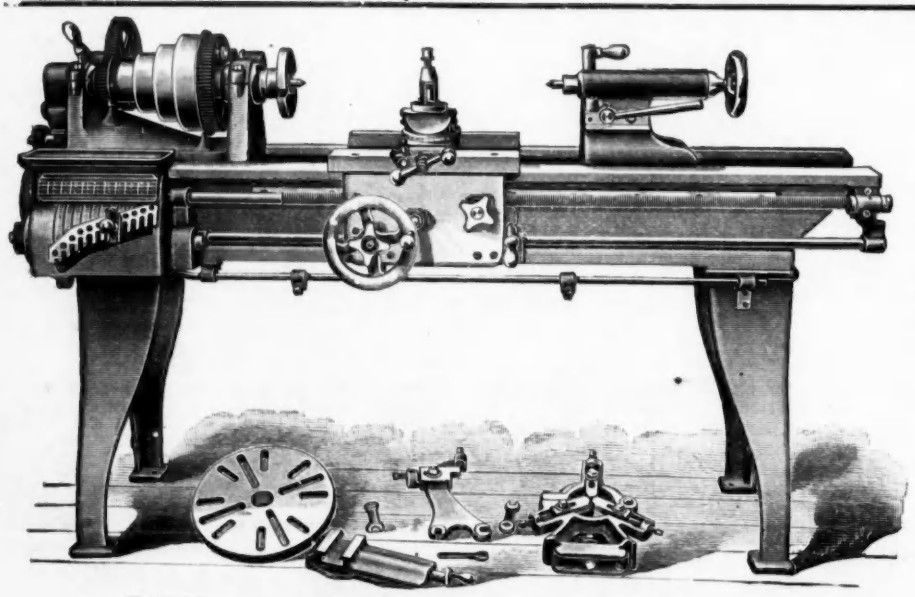

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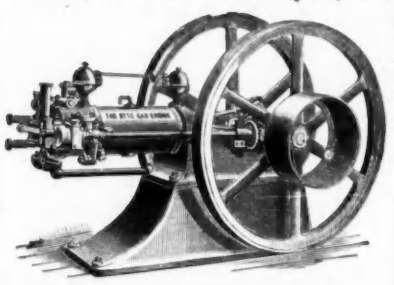

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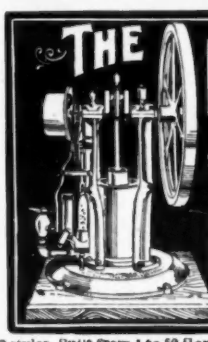

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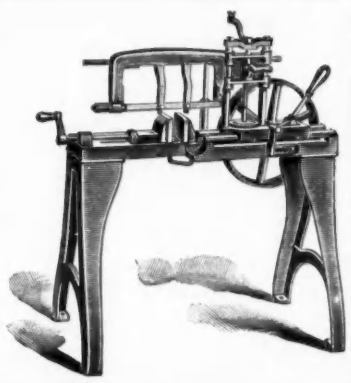

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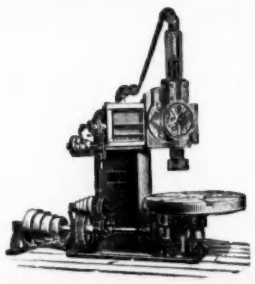

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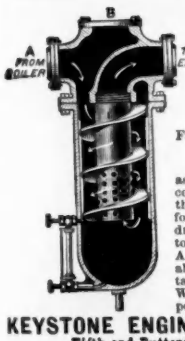

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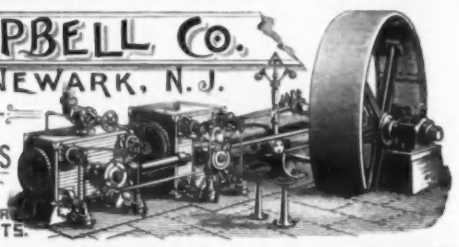

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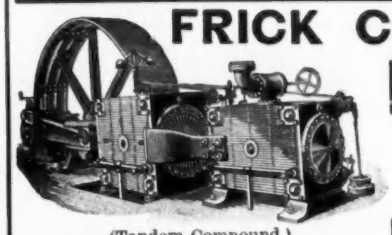

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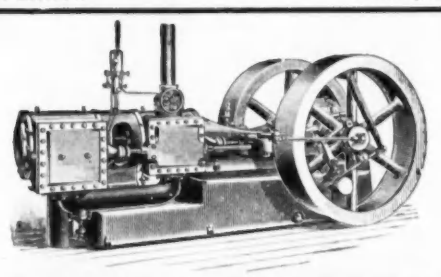

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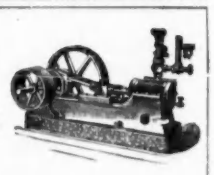

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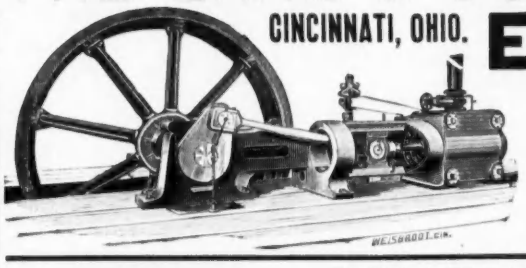

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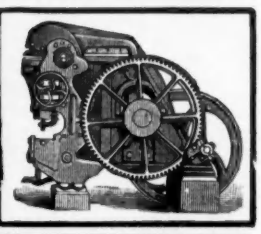

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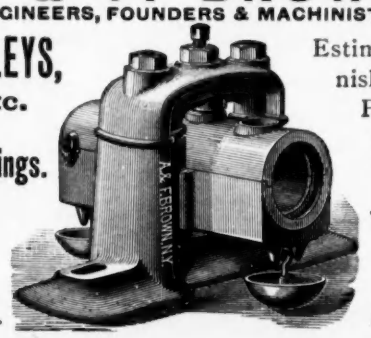

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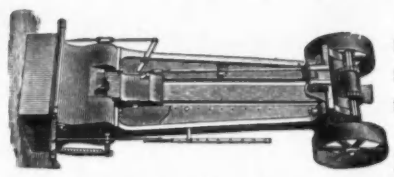

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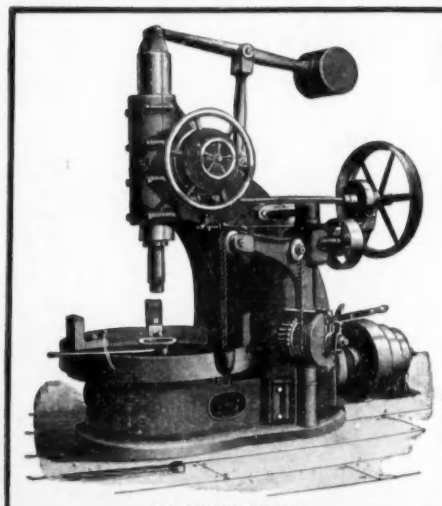

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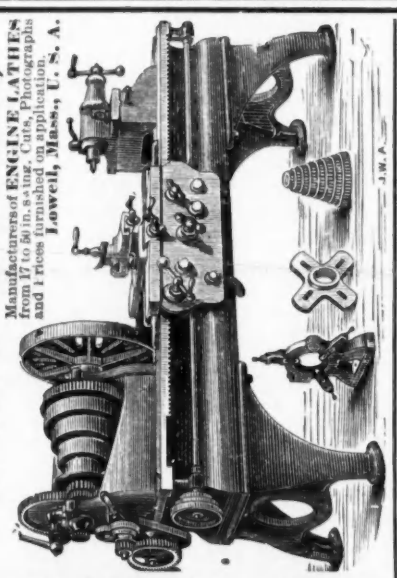

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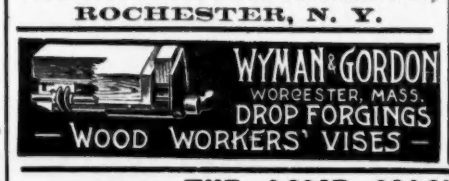

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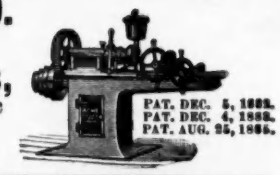

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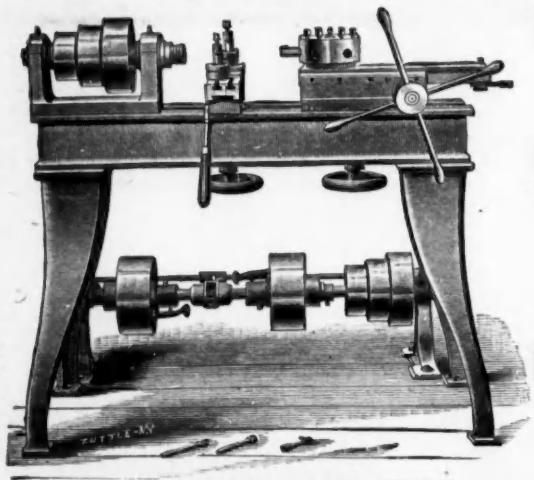

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